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COLONIAL DEVELOPMENT: THE PROGRESS TO PARTNERSHIP

THE selection of speeches by General Smuts which has recently appeared under the title "Plans for a Better World"* makes its appearance at an opportune moment when, as recent debates in the House of Lords and House of Commons on Colonial policy demonstrate, many of the problems which General Smuts discusses, including the idea of trusteeship which he did so much to promote in the mandate system, are coming under close and critical review. The volume includes his presidential address to the British Association at its centenary meeting in London; an address on science from the South African point of view; and another address delivered in 1927 outlining his theory of holism. In this glimpse of General Smuts's views on science the volume does something to redress a conspicuous gap in Mrs. Millin's "Life" of General Smuts, and the picture it gives of the wide interests and sympathies of the author, his versatile and imaginative mind is both fair and balanced.

Interesting as is this glimpse of the secret of General Smuts's real strength—and his speeches on the Statute of Westminster, the Commonwealth Conception, his St. Andrews' rectorial address on the challenge to freedom, the Rhodes Memorial Lecture on native policy in Africa read as vividly to-day as when they were delivered ten or even twenty-five years ago, or as those of last year on "Investing in Friendship" and "A Vision of the New World Order" with which the volume closes—it is of even greater interest as illustrating the evolution of outlook and policy which is taking place in South Africa and elsewhere. That evolution is exemplified strikingly in the thought of Smuts himself. Between the views on segregation expressed in his Rhodes Memorial Lecture at Oxford in 1929 and those of his speech at Cape Town in January of this year, in which he admitted the failure of segregation, and of his still more recent "The Basis of Trusteeship", there is no small advance.

The debates in the House of Lords on May 6 and in the House of Commons on June 24 well show the extent to which the War has already shaken conventions and opened men's minds. No one reading the full debates can doubt the reality of Parliamentary interest in Colonial affairs, however much yet remains to be done to quicken interest generally and to arouse public opinion to a sense of its full responsibility in these matters. Mr. Eden's plea for the future development of the Colonial Empire in his speech at Edinburgh on May 8 had already indicated the extent to which the problems of the Colonies are before the Government as it faces the tasks of the future, and the speech of Mr. Harold Macmillan, Under-Secretary of State for the Colonies, on June 24, made it perfectly clear that the policy of the Government towards the Colonies is in no way inconsistent with the high ideals of liberty and justice which have inspired the Atlantic Charter.

* Plans for a Better World. Speeches of Field-Marshal the Rt. Hon. J. C. Smuts. Pp. 288+8 plates. (London: Hodder and Stoughton, Ltd., 1942.) 8*s.* 6*d.* net.

The two debates in question followed somewhat different courses. That in the House of Lords put organization and administration in the forefront. In speaking on his motion on the staffing and administration of the Colonial Empire, Lord Trenchard endorsed views earlier expressed by Lord Moyne on the importance of efficient staff to enable the Colonial Office to deal effectively with social problems such as health, education and standard of living, and replan Colonial economics in production and marketing. Lord Trenchard made two proposals. First, he suggested the grouping of the Colonies into not more than a dozen areas, each having a governor-general and a central authority of its own responsible to the Colonial Office. These larger areas are necessary for purposes of defence, economic planning, medical research and the social services. The scheme outlined has points in common with one outlined in a recent *Planning* broadsheet; and in one of the suggested areas—the West Indies—there is already co-operation between Great Britain, the United States and the Netherlands, and in another—West Africa—between the British, French and Belgians.

This suggestion is in harmony with the general tendency towards larger units, and there are many fields in which the precedents of co-operation across national frontiers created during the present War may serve us well in the peace to follow. Lord Trenchard's suggestion is not indeed inconsistent with the continued existence of the smaller unit, which will still have its functions, especially among undeveloped peoples, but it might well provide the means of more effective international collaboration than has hitherto been possible under even the mandate system. In supporting this proposal later in the debate, Lord Hailey clearly indicated that in his view it offers possibilities of building up new and more responsible forms of self-government on the basis of existing local customs and institutions, especially where the units are too small in resources or with little political balance to attain responsible government or the position of a dominion themselves.

Another proposal made by Lord Trenchard was for the establishment of the Colonial Service, at home and abroad, as a single, interchangeable service, independent of the rest of the Civil Service, and that appointments to the Service should be based to a much greater extent on selection. While placing recruitment on the broadest possible basis, he urged that all types of recruit should be given first a year's training in a university which might in time come to be regarded as specially concentrated on Colonial interests. Lord Trenchard also advocated outside recruitment at the top of the Service, and warmly welcomed Sir George Gater's appointment to the Colonial Office. He also endorsed Lord Moyne's proposals for proportional pensions to facilitate retirement of Colonial officials.

Two other recommendations were advanced by Lord Trenchard as even more vital: first, the establishment of a Colonial Advisory Board, and, secondly, a Colonial Staff College to which the abler and more promising men in the Service would be drafted for a course at the age of about thirty-five. The aim would be to bring them in constant contact with each other and with the outside world, to broaden their outlook, and to stimulate their enthusiasm so as to encourage a progressive and constructive spirit. Furthermore, Lord Trenchard looked to a representative Colonial Council to stimulate and focus public interest in the Colonies and bring informed opinion to bear upon them.

Generally speaking, Lord Trenchard's proposals were well supported in the debate which followed. Lord Moyne considers that recruiting should be very much on the lines suggested, and he and Earl De La Warr, and also Lord Hailey, stressed the importance of bringing the largest possible number of native-born Africans and other Colonials into our Government services. Lord De La Warr pointed out that in great portions of Africa education and health must be treated as one subject, but in place of a Colonial Staff College he suggested a system of travelling scholarships. He stressed, too, the importance of more enterprise and courage in administration, more attention to the right political development, to the things that are the foundation of life, the intelligence, health, food and economy of the native African population. The Colonial staff should be chosen, organized and trained with that essential purpose in mind.

In Lord Hailey's tribute to the present capacity of our Colonial Services, he, too, emphasized the need for men capable of dealing with economic problems, an aspect which has hitherto received insufficient attention in the Colonial Service, but he agreed with Lord De La Warr as to the high quality of some of the younger and more recent recruits. Lord Hailey doubted whether a fully interchangeable service is desirable, although he believes that interchangeability would do something to enhance the position of the Colonial administrative service and that the Colonial Office would gain substantially through the presence of a much larger number of men with actual experience of executive work and its requirements. In his view, the ideal would be to have a staff in the Colonial Office composed partly of men from the Colonial administrative service and partly of men who have had experience in other departments of Home Government, officered by the home Civil Service and departments, which deal with so many activities, social and economic, now forming an increasing part of the work of the Colonial Office. Lord Hailey insisted once more on the importance of the conception of the State as the chief agency for social welfare, which, forcing its way into Colonial politics, is giving us a new and more constructive and beneficial interpretation of trusteeship without diminishing its moral quality.

Viscount Elibank, in supporting the idea of a Colonial Staff College, advocated, not so much the refresher courses, as selection at an earlier age on the lines of the selection of Rhodes Scholars, while Lord Faringdon, referring to the friction between technical and administrative services which is liable to arise under the selection system of recruitment if the administrative service holds a superior position, believes that a college to which all aspiring Civil

servants should be sent would meet the difficulty, and he supports the idea of refresher courses.

Lord Trenchard's speech was welcomed by Lord Cranborne, who in replying for the Government stressed the dynamic character of the British Empire. While interchangeability could not be so complete in the Colonial Service as it is in the Diplomatic Service, the desirability of the fullest possible mobility is fully recognized in the Colonial Office, especially in the technical branches of the Service where mobility is easier. Lord Cranborne stated that he intends to see that there is the greatest possible measure of interchange between the Colonial Service and the Colonial Office, and that this is one of the reasons for the appointment of Sir William Battershill as Deputy Under-Secretary and of Sir Cosmo Parkinson as his personal representative to maintain contact with the governors in the Colonies.

In regard to recruitment, the procedure proposed by Lord Trenchard is already largely the normal. Lord Cranborne hopes that selection on merit will remain the Colonial Service system of entry, and he does not believe that any alteration is necessary in the system of selection. The Colonial Office is already studying methods of improving the training of both the technical and the administrative services, and the idea of a further course of one or two years training for those who have had several years experience in the Service is under consideration. Lord Cranborne also warmly welcomed the idea of giving the Government powers of compulsory retirement of officers before their time is up, so that dead wood could be cut out. He promised full consideration of the suggestion of a Colonial Staff College; but he is dubious about the proposal for a Colonial Advisory Council and believes that advice should be given in Parliament and not by an officially appointed body. As to recruitment by bringing in new blood at the top, while that is often done, much harm could come to the Service if too frequent use be made of such powers by the Secretary of State.

The whole debate in the House of Lords remained at a high level, and in his closing remarks Lord Cranborne emphasized the importance of the right spirit pervading and inspiring policy and machinery. Without a moral and ethical basis, no Colonial Service could achieve what it set out to do and our Empire would not deserve to survive. That note was noticeably lacking in the House of Commons during the debate on Colonial affairs on June 24, which was indeed of a different character.

Mr. Harold Macmillan's speech was mainly concerned with the short-term aspects of Colonial affairs, in the course of which, however, he paid special tribute to the work of the Economic Department of the Colonial Office, which has been extended. In looking to the future, he developed the same outlook as Lord Cranborne, stressing the necessity for understanding and friendship as a basis for partnership. Changes or preparations for changes in the Colonial Service should have two chief aims: first to provide increasing opportunities for the people of the Colonies to fill posts in the public service of their own countries; and second, to provide a mobile force of highly qualified experts in administration, in science, in agriculture, in mining, etc., at the command of the Secretary of State to be posted wherever in the Colonial Empire they were most needed at a particular time. The unification of the Colonial Service which has been proceeding since 1930 is to be taken a stage further for this purpose in accordance with proposals initiated by Lord Moyne which are being worked out in consultation with the Colonial governors.

Mr. Macmillan then urged that our development policy should be considered as a whole and not in single compartments, and he went on to describe the various technical advisory committees which have already been appointed, of which the most recent is the Colonial Labour Advisory Committee. Special reference was made to Lord Hailey's services in the organization of research, which must cover economic ends as well as nutrition and education, etc. To promote the increased prosperity of the peoples in the Colonies scientific research must be applied to market needs. In the long run, the standard of living and the expenditure on social services in the Colonies depend on their economic prosperity, and the Colonial Development and Welfare Act is regarded as the instrument for long-term planning. Large-scale public investment on public needs will be required, and we should now prepare the plans and priorities for capital development so as to be ready to advance our demand for a fair share of reconstruction work for the Colonies.

It is clearly recognized by the Government that systems of government or administration alone are not enough; they must be supported by vigour, decision, imagination, ruthless and overriding zeal. That view was reflected in the subsequent debate, in which a proposal for a Colonial Development Board was strongly advocated by Capt. P. D. Macdonald and Squadron-Leader P. W. Donner. Pleading for a new conception of Empire, Capt. Macdonald suggested that the proposed Board should be a statutory body under the Secretary of State for the Colonies, and in addition to a representative of the Chiefs of Staff Committee, it should include full-time members for economy and finance, health, education and housing, and all the supply departments, with power to co-opt from outside on special sub-committees. It would take over the Colonial Development Fund, and Capt. Macdonald stressed the opportunity for real statesmanship and for adequate financial resources. The five millions of the Colonial Welfare and Development Board should, he suggested, be used to pay the interest on the far greater loan of two or three hundred million pounds which is really required to tackle on an adequate scale the problems confronting us.

Squadron-Leader Donner suggested that the Colonial Development Board should have the four principal functions of the Imperial Development Board suggested by the Royal Commission of 1917. It should promote first new sources of supply, and secondly new measures for the prevention of waste; thirdly, it should investigate the possibility of finding substitutes, and fourthly, would stimulate scientific research. Recalling the weakness of the Colonies in

regard to research—a position on which the Royal Commission had commented—Squadron-Leader Donner said that our Colonial administration has been weakest in dealing with economics and development.

Mr. Macmillan promised to examine the suggestions carefully, and while dubious as to the desirability of establishing the particular organization suggested, recognized the importance of study and research as a basis for policy. Instruments for making and executing plans must be included, and some continuity of policy preserved in capital development in future. In regard to the suggestion for an assurance in realistic and convincing terms, pointing the way to freedom, equality, responsibility, and the reconstruction of Colonial economic and social life, Mr. Macmillan referred to the Joint Declaration and the Prime Minister's explanatory comment.

Though it could not be said that the debate touched the high level of that in the House of Lords, it is clear that many members of the House of Commons are alive to the grave issues and responsibilities involved. Mr. R. W. Sorensen made several valuable suggestions. We should see that the whole of the Colonial Development Fund is expended on development, if not in the particular year allocated, then in the following year. Friendship between the black peoples and ourselves should be fortified by a comprehensive scheme of educational development. Our medical services also require drastic development, and if enforced labour is required, we should see that the finest conditions that can be secured are granted to the people. Finally, we should consider drawing up a plan of constitutional and political development in West Africa as well as in the West Indies.

The emphasis which is rightly being placed on economic development as the basis for Colonial stability and prosperity, and on international co-operation in the attack on such problems as soil erosion and tropical diseases, if adequate technical staff is to be available, should not lead us to overlook the importance of some of the other basic conditions and principles inherent in the idea of trusteeship or partnership between the peoples of the world on which the Atlantic Charter is based. It is not solely a matter of more imagination and creative insight in fostering the growth of self-government through new institutions more adapted to Colonial conditions than the outward forms of British institutions. Equally with economic development must come educational development, not merely of the few who must be drawn into the active conduct of affairs, but also of the many, so as to eliminate the psychological errors, misunderstanding and apathy that have thwarted in the past well-meant but erroneously conceived administrative measures. In this we must, as Mr. I. L. Orr-Ewing pointed out in the House of Commons, redress our failure to popularize education among African women, and also the tendency to excessive concentration on book-learning in education. We must educate the African to be a good African and not a mediocre European, and to develop on his own traditional lines.

That the pre-war official or accepted conception of Colonial policy is now inadequate as a guide can scarcely be questioned. The two principles of fulfilment of the obligations of trusteeship and of assisting the dependent units of the Empire to attain self-government are not really definite enough. The first is negative rather than positive, corrective rather than constructive, and, as Lord Hailey has pointed out, its moral standards are liable to too many interpretations to be a satisfactory guide. The inadequacy of the second was fully exposed in the House of Lords debate, and if we are to bring new life and strength into the system the first step may well be, as Lord Hailey suggests, the restatement of our relations not as between trustees and wards, but as senior and junior partners, on terms which recognize that the latter must as of right acquire an increasing share in the control of our common undertaking. Moreover, as we apply to the Colonial empire the conception of the State, not merely as an agency for maintaining justice or preventing abuse, but also as the most active agency for promoting social welfare and improving the general standard of living, our obligations to the Colonial peoples become not those of trustees but those incumbent on the modern State in regard to the improvement of the social services and the standards of living in its own backward areas.

That shift of emphasis in itself should prove a powerful solvent of misunderstandings and friction. By the stimulus it gives to the self-respect of the Colonial peoples it should promote the more rapid development of representative local institutions, and the full participation of the people of the country in their own administrative services. Moreover, building firmly on the basis of existing institutions so as to assist the evolution of forms of self-government best suited to the traditions and circumstances of the people should also assist in that co-operative attack on the great problems of health, nutrition and the conservation as well as development of natural resources, which will be essential on an international scale as well as within the bounds of our own or any other Colonial Empire.

CYNIC SCIENCE

The Scientific Life

By Dr. John R. Baker. Pp. 154. (London: George Allen and Unwin, Ltd., 1942.) 7*s.* 6*d.* net.

DIOGENES had only one request to make of Alexander: "Keep out of my sunlight". Insolation, to the Cynic, was what the bath, the omnibus, and the tea-tray have been to eminent physicists and chemists; and in a world overshadowed by a planned technology, Dr. Baker takes up the cause of individual freedom for men of science.

That technology is something quite distinct from science, as we understand it, Dr. Baker has little difficulty in showing. That a planned technology, which is essential and inevitable in a time of national crisis, necessarily threatens the freedom of scientific discovery, is less easy to prove. He notes unfavourable

portents. The capital letters in the Wordsworthian motto of NATURE were deranged "about 1935"(p. 130), but this the Editors may restore, or replace by lower-case, which is always in anti-capitalist majority. [The change was made on the representation of scholars in order to make the quotation conform with the accepted Wordsworth text.—EDITORS.] The British Association has held a conference, and published a "Declaration of Scientific Principles" which amplified (without transgressing) its century-old commission "to give a stronger impulse *and a more systematic direction* to scientific enquiry, and to obtain a more general attention to the objects of Science, and a *removal of any disadvantages of a public kind* which impede its progress". M. Maisky has stated that "we in the Soviet Union never believed in so-called 'pure' science. We always believed that science must help humanity in its needs", in the course of an appeal which we may hope is unnecessary here, to put "first things first" in a dangerous emergency.

Dr. Baker gives entertaining and picturesque examples of the personal habits of men of scientific genius, which might be capped by those of great artists, poets, and other unusual people. Some great soldiers—and other 'planners'—have also exhibited their need of freedom. But this is the 'common-sense' or 'magical' argument which he ridicules (pp. 115–16): to make his proof secure, as one man of science to another, he must be asked to give negative and crucial instances. He does not seem to extend his protest against the use of men of science in technological research to the employment of them in another useful art, education. Indeed he carries compromise so far as to admit that teachers of science may be required to lecture punctually and on prescribed subjects, and members of a research institute to co-operate in its programme of research. It is not so long ago that the Association of Scientific Workers was upholding the right of teachers and research workers alike to reasonable conditions of pay, leisure and freedom of speech; and it is odd that some of the academic fracas of recent years have arisen over the demand of men of science for freedom, not of scientific thought or expression, but in the exercise of those civic functions which Dr. Baker regards as incompatible with the "scientific life". Here is Dr. Baker himself compromising his own 'scientific life' by this counterblast to 'planned economy' by or for a 'progressive class': a case of real self-discipline. One wonders whether the geese who saved Rome ceased to lay.

Dr. Baker rather damages his own generalization by admitting (p. 36) that at certain times "if one person had not made the discoveries, another, nearly as good, would probably have done so", distinguishing science from music in this respect. But if "the genius in science is not a man apart" (p. 37), what becomes of the case for treating him as if he were?

For his general thesis that the desire for knowledge begins in wonder and curiosity, rather than in the desire for control, which leads to technological invention, there is much to be said. It is an aspect of the general distinction between science and technology, between discovery and invention; and it is not surprising that those who fail to distinguish these should overlook it. Dr. Baker's analogy, already noted, between science and music, between the disinterested quest of truth and the quest of beauty, is well grounded. He might have added the quest of goodness, which like the quest of truth has its technological counterpart in the social sciences, which study how to *be* good, or to *multiply* goodness among men; for this also does not originate in the desire to control evil, or lead to the effort to do so, but rather, as its votaries say, 'to see God' without consequence or corollary. Theories of origin, however, do not prejudge the claim of the disinterested 'seeker after truth', or after beauty or goodness, to freedom of thought and expression. They are only relevant in so far as they help to explain the inability of able technologists, as of some able composers, to recognize the division between disinterested and interested inquiry. Dr. Baker quotes the statement (p. 104) that "nearly all scientific discoveries have proved of practical value", which is a tautology if 'scientific' means 'technological', but untrue if it means anything more. Such statements rather confirm his doubt whether we live in a "particularly scientific age" and his view that "even in subjects which are based on science, the scientific attitude is not absolutely necessary", meaning thereby the disinterested quest of truth. Just so, there are zealous and efficient social reformers who doubt or deny the possibility of "knowing the good" in the sense in which a man of science "knows the truth" in his discoveries.

If Dr. Baker's theory of scientific discovery as a conjunction of genius and occasion is true, every community probably gets its ration of men of exceptional insight. What matters is its method of recognizing them, and the use it makes of them when found. Here all parties seem to be agreed that they are likely to be better treated, and more productive of truth, if public opinion is sufficiently cultured to appreciate what they are doing and to provide for their needs, which are usually modest. It is not the discoverer but the inventor, who needs a palatial laboratory and a highly trained team. The inventor, moreover, usually knows better how to humour the unscientific theories or wishes of the patron or party, progressive or otherwise, who will pay the bill. In the arts it is the same; it is the great decorator who lives in kings' palaces and enhances their style of living; and he is not always a great artist.

It would be unfair to Dr. Baker not to note points in which his own presentation of the "scientific life" might be clarified. His classification of the sciences as basic, intermediate, expanded and eclectic is novel and needs explanation; for he seems to exclude mathematics, and to include psychology in biology—though he admits a "temporary gap" between psychological and physiological studies; he underestimates 'experimental' biology, which is as essential as 'experimental' physics; he includes geographical distribution under biology, though volcanoes are geographically distributed, and animals and plants depend for their diffusion on soils and climate; and he overlooks the 'observational' side of pharmacology, where Sir Henry Wellcome spent large sums fruitfully on the folk-lore and folk-medicine of remoter peoples. His use of well-established terms like 'substance' and 'form' is perplexing; he speaks (p. 95) of the "analytically minded person" as interested "in substance rather than form, in the general rather than the particular"; but perhaps he is one of those persons "untrained even in the elements of logic" who are "usually logical enough for all the purposes of ordinary scientific research" (p. 89).

Dr. Baker has several suggestions for the advancement of science: more Nature reserves, more amateur naturalists, a society "for mutual help between them and the professional scientists"—the original project of the British Association; a journal more suited

than NATURE to their needs; museums like those advocated by Flower fifty years ago, and locally realized. Will Dr. Baker take a hand in the museum at Oxford?

But all these enterprises imperil the Cynic seclusion of potential discoverers. Either they must be left to chance-and-genius, like scientific discovery, or somebody must attend to them; and this means planning such applications of science; the maintenance of an "environment in which culture is respected" (p. 139); the "elimination of snobbery"—of homage to political influences, "progressive" or otherwise; and, most important of all, the replacement of one generation of men of science by another, through scientific teaching. "Already the majority of research workers spend a large part of their time in teaching, or in other work in which complete freedom is impossible" (p. 50), and Dr. Baker's planning seems likely to diminish their freedom. It is all very sad; the best we can do is to "keep out of the sunlight" of the Cynic who comes in our way, and encourage the "progressive classes" to do the same.

JOHN L. MYRES.

PHYSIOLOGY OF VISION

Vision

A Study of its Basis. By S. Howard Bartley; with an Historical Perspective, by Edwin G. Boring. Pp. xv+350. (London: Macmillan and Co., Ltd., 1941.) 18s. net.

AFTER a period of stagnation, the last twenty years or so have seen a remarkable revival of research into the complex and difficult problems of the fundamental physiology of vision. During this time great advances have been made in our whole conception of the state of adaptation of the eye, in our knowledge of the photochemical and electrical changes which take place in the retina and optic tract in response to stimulation by light, as well as of the correlations between different types of stimulus and the sensations produced. There has lately been an urgent need for a book, possibly on the lines of the "Recent Advances" series, which would make the results of modern research more generally available, and would, perhaps, show how such apparently separated subjects as, for example, the photochemistry of the retina and the study of visual sensation under different conditions can be brought together to build up a coherent picture of our present ideas about the processes whereby light, falling on the eye, produces the complicated visual sensations of which we are conscious.

No one who has tried to produce for students a clear picture of our modern outlook on visual mechanisms can fail to welcome Bartley's book. The author has very decided views on the way in which the problems of vision should be approached, and, because his book reflects them so strongly, he is likely to meet with a good deal of disapproval from many, if not most, experts in the subject. Bartley believes, if I read him rightly, that work on vision should approach the subject through the study of sensation rather than via the chemical and other reactions of the retina. He points out, quite rightly, that the final results of stimulation of the eye depend on the characteristics of the whole optic pathway, from the end-organs in the retina to the visual cortex, and that explanations of visual phenomena based on the behaviour of visual purple and the rods and cones of the retina, such as those produced by Hecht, are bound to be misleading. The author's insistence on the inadequacy of this point of view is timely and necessary; but, unfortunately, he has gone too far in the other direction and has, in consequence, produced a book which is, itself, both misleading and one-sided. This is a great pity since he undoubtedly spoils the force of a valuable argument by minimizing, and often altogether ignoring, much important work.

It is certainly true that the Duplicity Theory—which associates day-vision with the retinal cones and night-vision with the rods and visual purple—no longer provides a sufficient explanation of all the phenomena, but this does not detract from the importance and validity of the facts on which the theory was originally based, as well as of recent results which support it. Completely to ignore this body of knowledge, as the author does, in a discussion of dark-adaptation, for example, cannot, to put it mildly, really help in the clarification of the problem. Any consideration of the problem of vision as a whole must include the question of how light is able to initiate nerve impulses as well as how these impulses give rise to conscious sensations. Light energy must act through the medium of photochemical substances, and to ignore all that is known of at least one such substance in the retina is surely odd in a book the title of which is "Vision: a Study of its Basis".

The greater part of the book deals with recent work, much of it the author's own, on sensation. The chapter on the visual perception of movement is particularly valuable, both for its description of experimental work and for its theoretical discussion. There is also a very interesting discussion of the dependence of visual acuity on changes in illumination. The author points out the difficulties in the way of reconciling present-day theories of the effects of raising the illumination on interaction between different parts of the retina with the fact that increased illumination undoubtedly also increases visual acuity. In this connexion, it is a pity that he seems to be unaware of Polyak's recent work on the micro-anatomy of the primate retina, because this worker's demonstration that only some of the retinal cones bear a one-to-one relationship to their optic nerve fibres should help to elucidate this particular problem.

It is good to find, at last, a comprehensive account of the work on the electrical changes in the retina and optic nerve in response to light. Great advances have been made in this subject recently and results of considerable interest, not only from the point of view of vision but also of sensation in general, have been obtained; and Bartley's account is, on the whole, a clear and full one. One cannot, however, help but deplore the fact that his suspicion of photochemical explanations of retinal activity should have led him to omit any reference to the formidable body of evidence produced by Granit and his colleagues to associate the *b* wave of the electroretinogram with the presence or absence of visual purple. In this section, also, very much less than justice is done to Hartline's truly exquisite work on the electrical responses of single optic nerve fibres—work which has been of so much value in helping us to understand the reactions of this nerve as a whole to stimulation.

It is probably true that attention has lately been too exclusively directed towards the retinal end of

what might be called the visual chain, and that the author's contention that we can now learn more about vision by studying the physiological psychology of visual sensation rather than the details of retinal activity should, therefore, be seriously considered. Those who wish to learn more about recent developments on these lines will certainly find his book extremely useful and satisfying.

KATHARINE TANSLEY.

INDIAN FOREST UTILIZATION

Manual of Indian Forest Utilization

By H. Trotter. Pp. x+419+18 plates. (London: Oxford University Press, 1940.) 30*s*. net.

THE embarrassing richness of well-forested tropical countries is in itself a handicap to the economic utilization of their timber resources. It is no easy task to select from some hundreds of different timbers those which are most suitable for each particular purpose; instead, the usual practice has been to concentrate on a small number of primary hardwoods which have been found by experience to be durable and generally suitable for everyday needs. This works very well so long as these timbers are plentiful and cheap, but there comes a time when the demand overtakes the supply, prices soar, and it becomes necessary to turn to the lesser-known woods which make up the bulk of the country's forest resources. This was roughly the position in India twenty-five years ago. The timbers most in demand for ordinary purposes were about a dozen in number, among which teak (*Tectona grandis*), sal (*Shorea robusta*), and deodar (*Cedrus deodara*) were pre-eminent. Shortly before 1914, the inevitable began to happen; as a result of the World War, the demand for timber rose with alarming rapidity and the study of the secondary timbers of India was taken up in earnest.

The present War finds other parts of the Empire in somewhat the same position as India was twenty-five years ago; in some cases their state is worse, because of the quantities of Baltic and North American softwoods which they have been importing while their local timber supplies remain undeveloped. Without necessarily taking Indian practice as a model, these countries may still learn much from India in forest utilization.

In the volume under review, the important question of replacing the relatively scarce standard timbers of India by others in more plentiful supply is tackled in commendably practical fashion. The principal uses of wood are dealt with in turn and the chief requirements of a timber for each particular purpose are clearly stated. Timbers for bridge-building, to take a simple example, require to be strong and durable. A descriptive list of representative timbers suitable for this purpose is followed by a table of relative strength values, as a guide to anyone seeking the best structural timber in his particular district. Under the heading of vehicle construction the essential characteristics of timbers for the framework, axles, hubs, spokes, felloes, etc., are set out, and suitable species are recommended for each part. The manufacture of matches is an example of a highly developed timber-using industry which is very exacting in its demands. Strange though it may seem, there are very few woods really good for making match splints and match boxes. Analysis of the requisite properties, however, shows how strict is the specification for a timber which will compare with imported aspen, the match wood *par excellence*.

The way in which standards of quality are determined by the materials available is strikingly illustrated in the case of joinery timbers. The outstanding characteristics of an acceptable timber in this class are that it should be cheap, plentiful and not too hard to work. In Europe and North America, the so-called softwoods (pine, spruce, fir, and other coniferous woods) have long since taken the place of oak for three quarters of the joinery work. In the greater part of India, however, conifers are not easily available and the joiner is accustomed to use hardwoods, some of them so hard that they would be regarded with horror by his opposite number in Europe. The greater labour in working hardwoods is offset by their superior strength and lasting qualities, which render them more suitable than softwoods for work of a permanent nature, especially in the tropics. It is unfortunate that the prejudice in favour of softwoods has spread from Europe to many parts of the tropics before local timber resources have been developed sufficiently to hold their own. The imported softwood has the advantage that it is well sawn and seasoned ready for use—an important consideration to the contractor; on the other hand, it is not very resistant to the fungus and insect pests which attack timber in tropical climates. In every forested tropical country there are indigenous hardwoods which are known to be superior to softwood, and it should only be a matter of time before they replace the imported material. It is essentially a matter of organizing local resources.

The chapter on the uses of wood from which examples have been taken is an admirable summary of the technical data on individual timbers accumulated in the records of the Forest Research Institute, Dehra Dun. The other chapters dealing specifically with timber cover the structure and properties of wood, felling and conversion, transport, storage, and the important auxiliary industries of seasoning, preservation and wood-working.

A substantial portion of the book is devoted to the so-called minor forest products which are of such enormous economic value to India. Some of these are the basis of important industries: lac, turpentine and rosin, charcoal, and paper pulp, for example, are each given a separate chapter. Others are conveniently classified under half a dozen headings as fibres and flosses, drugs and spices, oilseeds, distillation products, tans and dyes, etc. Many of these commodities are the subject of monographs, but so far as I am aware, there is no single volume readily available which covers the whole field. This part of the book, therefore, will be of particular interest to anyone seeking a brief elementary account.

Of the book as a whole it may be said that the author has given the reader what he wants to know in a form in which he can easily utilize it. The preface states that it is intended primarily as a text-book for Indian forest ranger students, but there can be no doubt that it will also be welcomed by senior officers of the Indian Forest Service and will be found useful for reference by a wider circle of readers. It is only to be regretted that the author has not seen fit to include at least a short bibliography of forest department publications and other more exhaustive works which the reader may wish to consult for fuller details.

B. J. RENDLE.

EDUCATION AFTER THE WAR

By M. L. JACKS

Director of the Department of Education, University of Oxford

THERE are to-day signs of intense activity on the whole educational front, and local advances are being planned and discussed and sometimes put into execution on many sectors. This movement is to be warmly welcomed, but it has in it certain dangers: of these the chief is that it is largely an unco-ordinated movement. This may be inevitable at the present stage of development, but it is a feature in the situation which should be brought to an end at the earliest possible moment. Until the campaign can be seen as a whole and a proper strategy worked out for carrying it to a successful conclusion, there is a grave risk of our frittering away our forces in tactical advances which are of no ultimate value, in concentrating our strength at one point and weakening it at another equally vital, and in occupying positions which are only tenable (and indeed only worth holding) if an advance is made along the whole line. It is to this advance of the whole line towards a comprehensive objective that we must devote our attention. *Quo vadimus?* In this article I shall endeavour to set up three direction posts and to indicate briefly to what they point. To drop the metaphor, I shall suggest three general principles which should guide our planning of post-war education, and apply them to certain practical problems.

My first principle is the principle of *wholeness*—the wholeness of the child, and the wholeness of his educational experience. Education viewed from this angle might be described, on the analogy of total war, as *total education*, and those who care to work out the analogy will find in it much that is suggestive and helpful. It has not been our custom in the past to educate our children as integrated wholes: our tendency has been rather to analyse them into wholly artificial parts, and then to try to educate these in isolation from one another. Thus we have adopted a tripartite division into body, mind and character, which has become traditional: the body we have educated (or rather exercised—by no means the same thing) on the playing-field, the mind in the class-room (and for many this has comprised the whole of education), and the character in the give-and-take of school life; there has been little deliberate effort to educate the will or the emotions. The result has been that not only have we failed to educate the whole man and have turned out from our schools those unbalanced personalities which are such a danger both to themselves and to their fellows, but we have also not even succeeded in educating any one of the three parts; for the truth is that we cannot educate one unless at the same time we educate all the rest. "A teacher comes to grief", says Prof. Whitehead, "as soon as he forgets that his pupils have bodies."

Education, if it is to be effective, must always mean the co-education of all parts of the human personality. To take a particular illustration, physical education can never be an end in itself or limited in its objective to the body; to demand this, and to make a meaningless 'physical fitness' our end, is self-defeating. Physical education means the education of the whole man through his body, a truth of which Plato was aware when he said that "Gymnastic" was primarily for the soul. To act on this principle of wholeness will clearly mean considerable changes in our choice of subjects and in our methods of teaching them; we shall have to make a deliberate attempt at synthesis in constructing our time-tables and in organizing our school-life, so that a day at school may become a piece of intelligible tapestry instead of the patchwork quilt which it so often is. We shall have to change our very conception of a 'subject', and perhaps give up the use of the term (and a good riddance), substituting for it the conception of an activity, and the activity of a whole human being. This human being, moreover, is a whole *now*, and there is a wholly right life for him to live to-day; to provide that life is to educate him: education is not a preparation for something else, for a distant and uncertain future, for earning a living or citizenship or life, but is a whole life (and a different life) to be lived by each child here and now; out of that life the right future will develop as the flower from the bud.

Moreover, the process must cover the whole period of childhood and adolescence; up to the age of eighteen (at least) the boy must be subject to educational authority, and if he leaves school for part-time employment in a factory at fifteen or sixteen it must be because it is there that his education can best be carried on. This is very different from the continuation school plan, under which a controlling industry will let off an employee for so many hours a week to continue his education. Industry can play its part by friendly co-operation with the school, by stressing the educative side of its young employees' work, and perhaps by the establishment of works' schools. Such an educational scheme implies a social revolution; but education and society are so closely interwoven that the revolution which we all see to be necessary in one cannot be carried out without a parallel revolution in the other.

So much for wholeness. My second principle is that of *comprehensiveness*. The connotation of the word 'education' has immensely widened since the days when it stood for little more than the three R's, and it is widening every day. We now know that education means much more than teaching even a vastly increased range of subjects; it means the provision of everything a child needs for the discovery and full development of all his potentialities—physical, intellectual, emotional, moral and spiritual. Nutrition and health, milk and meals, rest and sleep, cleanliness and clothing, the encouragement of aptitude and creative skills, the growth of emotions into valuable sentiments, training of the æsthetic sense and of social attitudes, vocational guidance; all these are properly part and parcel of the educational process for *all* boys and girls, and not only for those who, by reason of home circumstances, seem to stand particularly in need of them; it is very often those who seem to need them least who do in fact need them most, and none of these elements in the educational process must be tarred with the brush of State-charity.

There must be, moreover, a new marriage between the cultural and the technical, and that false and unfortunate dichotomy must be ended in a new conception of twentieth-century culture. The old dividing line between a 'liberal' and a 'vocational' education (never a very clear one) must be erased wherever possible, and we must so teach our more specifically cultural subjects that their vital relationship with the technical may be recognized, and so teach our

more specifically technical subjects that their full cultural possibilities may be realized. The curriculum, moreover, must be widened. There has been a rapid movement in this direction during the past thirty years, a movement to which evacuation experiences have given an added drive; many schoolmasters, evacuated to a new environment and compelled by the exigencies of war to devote the time of their pupils to activities which have never hitherto fallen within their purview, have found, to their surprise, that these activities are often more educational than the class-room subjects whose time they have usurped. It is to be hoped that this lesson of evacuation will never be forgotten. But a wider curriculum can only be maintained if it is accompanied by greater freedom of choice on the part of the boys and girls for whom it is provided. We need a much greater variety in post-primary education, whether this takes the form of a greater variety of schools or a greater variety of 'sides' within the same school. I can visualize a post-primary education in the future of which the staple constituent will be book-learning as in the secondary school with which we are familiar, and at the other end of the scale an education in which book-learning will be almost non-existent, with infinite gradations in between: I visualize schools which are more like clubs, new types of boarding-schools (on the lines of the present camp-schools), schools which are day schools up to a certain age and boarding-schools beyond that, and many other varieties. Only in such a variegated field shall we be able to attain that 'equality of opportunity' in education which is to-day a popular slogan, but like most slogans very ill-thought out. It does not mean equality of opportunity to attend a certain type of school enjoying a fictitious prestige, or equality of opportunity to go to the university. It means that every child should enjoy an equal opportunity with every other child to receive *the right education for him*, and that means that we must have available types of education to meet the needs, intellectual, moral, physical, and spiritual, of all children.

My third and final principle is that, in a far more real sense than ever before, *the schools should serve the community, and the community the schools.* The community demands that the product of education should be the good citizen; the individual demands the development of a unique personality. These demands are often regarded as contradictory; they are in fact complementary, for the fully developed individual is the life-blood of democracy, and the best citizen is the man who has been given the opportunity, and has taken it, to become his best self. This truth is more likely to be appreciated, and the duty of the community to the school and of the school to the community is more likely to be performed, if there is a much closer association between the two. On one hand there should be no schools outside the national system. This does not mean standardization, or the reduction of all schools to the dead level of the few categories which we know; for the national system itself is capable of expansion to embrace a much wider variety of schools than it does to-day, and there should be room within it for all those diversities of educational life and experiment represented by schools which are at present independent of public support: given public support, they must, of course, be open to all who can profit by the education they offer, and our ideal should be schools common to all classes but diversified in type.

The two essential freedoms to safeguard are the freedom of the parent to choose his child's school, and the freedom of the school to choose its pupils, both freedoms being exercised within wide limitations. This association between school and community can be further fostered by the encouragement within the school itself of realistic social studies. I do not mean by this courses in civics or current affairs, though these may have their importance. But citizenship is best learnt by practising it within the school community, and its significance can best be appreciated by the study and use of the community immediately outside the school walls. The locality should, in fact, be the first text-book of every school. If that can be done, there will be less danger of that community-sense which many of our schools foster (and particularly our boarding-schools) stopping short, as it so often does, at a school-community-sense, and a bridge will be built (one of the most difficult bridges to build) between school and 'real life'. That should be the beginning of an outward movement which will end in the world-community claiming the allegiance of the world-citizen.

Finally, the 'walls of partition' must be broken down from the outside as well as from the inside, and if the school is to go out to the community, the community must come into the school. To some extent this is being done, and it is symbolical of the change that, whereas in the nineteenth century schools were surrounded by high walls and locked gates, to-day they are commonly built open to the streets and the gates are rarely shut. But the flow of traffic through this open gate is not yet as free as it should be. There is no reason why the industry and the craftsmanship of the neighbourhood should not find their way into the classroom and display their wares and expound their ways of life there—invaluable recruits to the teaching profession; there is no reason why other recruits should not be found among representatives of the local authority and of the professions; there is no reason why the schools themselves should not become community-centres for education, providing classes and courses and cultural activities for children in the day-time and for their parents in the evenings. In these ways social studies would become a real and vital element in the curriculum, and the association between school and community would be complete.

Much has necessarily been left unsaid in this article. No mention has been made of the universities or of adult education: the whole field of religious education has been left unexplored—if explored, it would be found to affect profoundly not only the curriculum, but also the whole organization and administration of the school; and nothing has been said about the training of teachers or the relationship between teaching and other forms of youth service. But I hope I have succeeded in erecting certain pointers to the education of to-morrow.

STRUCTURE AND ROTATION OF GALAXIES

A SUCCESSFUL and well-attended symposium on the structure and rotation of our own Milky Way system and of external galaxies was held at the rooms of the Royal Astronomical Society in Burlington House on July 10.

The discussion opened with a contribution by Dr. A. Hunter on interstellar absorption and the scale of

the Galaxy. Pointing out that the absorption produced by interstellar matter is important in studies of galactic structure because of the effect which it may have on estimates of stellar distance, Dr. Hunter went on to review modern methods of determining great distances in astronomy. Except within about a hundred light-years of the sun, the distance of a star is found by comparing its apparent brightness with its true brightness, this latter being estimated by physical examination of the star's light. The distance then follows by applying the inverse-square law. If this law does not hold, however—if, for example, we attribute wholly to the effect of distance dimming which is partly due to absorption—we shall over-estimate distances by amounts which may be very serious if the absorption is heavy. In the past decade many attempts have been made to determine the absorption in various directions. Nearly all depend on comparing photometric distances of distant objects determined as outlined above with distances inferred by geometrical means. Trumpler, for example, arguing that the diameters of physically similar clusters ought to appear smaller in proportion to their distance, found that distances so estimated could only be reconciled with photometric distances by assuming an average absorption of 0·67 stellar magnitudes for every thousand parsecs.

Other work on broadly similar lines has more recently led to much the same result for observations made close to the galactic equator. Hubble's results on the dimming of extra-galactic nebulæ by absorption in our own system suggest that the obscuring matter is confined to a thin layer fairly close to the galactic plane. Meanwhile, spectroscopic observations of interstellar reddening in the light of distant objects of all kinds have been made by photographic and photo-electric means. Coefficients of this selective absorption depend greatly on galactic latitude and longitude, the reddening being greatest at low latitudes and towards the galactic centre. The correlation with distance is very rough, but the value of the mean coefficient taken around the galactic circle suggests that only about one third of the total absorption is selective. Our present picture of absorbing matter in the Galaxy is one of irregular clouds close to the plane of the Milky Way superposed on a thin stratum which dims the light of stars in and behind it according to a cosecant law down to a galactic latitude of 10° or so. Less than half this absorption is selective, the reddening caused by this part being due to particles scattering according to a λ^{-1} law; the rest is non-selective blocking, presumably by larger particles. The stratum extends to at least 2,000 parsecs from the sun, but we cannot say that it necessarily permeates the Galaxy: it may be (to this extent) local. The irregular obscuring clouds closer to the plane of the Galaxy produce heavy absorption and reddening. The recognition of this absorption during the last decade has roughly halved our estimate of the size of the Galaxy and thus incidentally brought it more nearly into accord with that of other giant systems.

Dr. H. Brück, in a contribution on the structure of the Galaxy with special reference to the neighbourhood of the sun, took up the question of the interpretation of star-counts made up to distances of about 2,000 parsecs from the sun. The density function derived from these data, assuming the form of the luminosity function (which is fairly well known), depends greatly on the value assumed for the interstellar absorption. Away from the galactic plane the absorption is small and interpretation is not difficult, but close to the galactic equator the analysis becomes less and less easy. If the absorption is assumed negligible, the well-known Kapteyn universe results, with the sun central in a universe of stars the density of which falls to 10 per cent of its central value at 500 parsecs along the axis of symmetry of the Galaxy and at 3,000 parsecs in its plane. Charlier's "local cluster" of *B* stars, with the sun eccentrically located 70 parsecs from the centre of a flattened system 700 parsecs in diameter and 250 parsecs thick, is now regarded as only the nucleus of a much larger cluster associated with Gould's belt. This cluster may itself be one of many star clouds which constitute the Galaxy as a whole; certainly the observations of galactic rotation prove conclusively that the sun is located at least 8,000 parsecs from the galactic centre. The steep negative density gradients of Kapteyn's universe cannot be eliminated by the assumption of a constant coefficient of absorption: if the absorption postulated is big enough to give constant space densities out to 1,000 parsecs, then rapid rises which are quite unlikely set in farther out.

The compromise due to Bok, who uses a coefficient of 0·4 mag./kpc., yields a density distribution which is roughly constant up to 1,000 parsecs in directions perpendicular to that of the galactic centre, which decreases rapidly towards the anticentre, and which first decreases (100–800 parsecs) and then rises again towards the centre. This tentative picture of a local system elongated at right angles to the direction of the galactic centre tempts us to believe that the sun is situated in a spiral arm of the Galaxy; but Oort's work leads to a very different conclusion. This is based on observations of stars of the 10th to 17th magnitude in galactic latitudes higher than 10°, and is thus independent of the worst irregularities due to absorbing clouds nearer the equatorial plane. On the basic assumption that all absorption has occurred before the mean distance of the 10th magnitude stars, Oort finds that the sun is in a region of low density surrounded in all galactic longitudes by higher densities. The suggestion here is that of a 'local void' between two spiral arms rather than a local cluster, and discrimination between the two hypotheses must await further observations.

Sir Arthur Eddington then gave an account of our present knowledge of the rotation of the Milky Way. The effect of galactic rotation is observable both in the radial velocities and in the proper motions of the stars, but the data from which its amount is determined are in fact confined to the radial velocities, the proper motions providing only confirmatory evidence. In the neighbourhood of the sun, the planetary-type motion distorts a cube of stars into a rhomboid by an action analogous to a shear; differential motion is then observed between the faces of the cube, and terms of the form $Ar \sin 2(l-l_0)$ are necessary to represent the observations. The rotational constant A is about 17 km./sec. per kiloparsec. The actual rotational velocity in the neighbourhood of the sun is obtained from radial velocities of distant clusters: it amounts to 250 km./sec., the distance to the centre of rotation being 10,000 parsecs (this agrees well with Shapley's figure when interstellar absorption is taken into account), and the total galactic mass being roughly 10^{11} times that of the sun. The time of one complete rotation is about 250×10^6 years, a figure which has remained unmodified since the pioneer work of Lindblad and Oort.

The observations of galactic rotation throw some light on the question of the reality of the local cluster discussed by Dr. Brück. Rotational shear in such a cluster would be expected to spread it into a ring—certainly a cluster having the shape of a flattened ellipsoid of revolution would be unstable in a rotating galaxy. This objection is quite independent of theory: it is an observational fact that shear exists in the neighbourhood of the sun, hence that any local cluster must be at best a transitory phenomenon. This view is supported by observations of the cosmic cloud. The interstellar atoms and molecules responsible for stationary lines in stellar spectra are widely distributed throughout the Galaxy and show the same galactic rotation effect as the mean of the stars. It can be shown that these interstellar particles must move with velocities corresponding to circular orbits, otherwise impossibly large density gradients would be set up; hence the stars, too, are so moving, and any local cluster could not persist. From this point of view Sir Arthur welcomed Oort's hypothesis as a way of avoiding the dynamically unstable singularities involved in the hypothesis of a local cluster.

The discussion was wound up by the Astronomer Royal, Dr. H. Spencer Jones, who took as his subject the rotation of extra-galactic nebulæ and their internal distribution of mass. Pointing out that the planetary-type rotation described for our own Galaxy by Sir Arthur Eddington referred only to the solar neighbourhood, presumably at about 10,000 parsecs from the centre, Dr. Spencer Jones turned to spectroscopic observations of the rotation of other galaxies. These referred until recently only to the bright central portions of such objects as *NGC* 4594 and 4111, the rotation of the nuclear regions of which is of the 'solid' type giving constant angular velocities.

Within the last few years, however, work at the Lick Observatory has made available rotational velocities for the Andromeda nebula (*M* 31) and *M* 33 out to considerable distances from their centres. The results of Babcock for *M* 31 show a period for the core of 11×10^6 years, and for the main body of 92×10^6 years, and indicate that much of the mass is in the outer regions. In *M* 33 Mayall and Aller find that the velocity increases at first linearly with radial distance from the centre, then faster until at the edge of the main body a maximum velocity is reached corresponding to a rotation period of 59×10^6 years. In the outer parts the velocity decreases again, the corresponding periods varying from 60 to 200×10^6 years. In these regions Oort's rotational "constant" *A* varies from 84 km./sec./kpc. at 1,280 parsecs from the centre to 30 km./sec./kpc. at 1,920 parsecs, a rough extrapolation indicating that at about 2,200 parsecs conditions of rotation similar to those in the solar neighbourhood would be reached. This in turn indicates that if *M* 33 and our own Galaxy are comparable bodies, the sun is at a distance from the centre of at least twice the radius of the main body, and that from an external galaxy the main body would appear only about 8,000 parsecs in diameter, the sun being well beyond this in the thin outer regions. The observed distribution of rotational velocity in both *M* 31 and *M* 33 can be adequately represented by a thin-disk model, possessing circular symmetry, the individual parts of which revolve in circular orbits about the centre in the plane of the disk. Assuming that in such a disk the surface density can be expressed as a fifth-degree polynomial in the distance from the centre, Wyse and Mayall have determined the curves of force and thence of rotational velocity for typical disks. Then by working backwards they deduce the density distribution in *M* 31 and *M* 33 necessary to fit the observed velocity curves.

A wide distribution of mass throughout both systems is indicated, little tendency being found towards the central condensation usually postulated for our own Galaxy. In *M* 31, for example, the model of best fit consists of two concentric thin disks, and indicates that less than 1 per cent of the mass is contained in the central regions. The total mass is $9{\cdot}5 \times 10^{10}$ suns, which agrees well with that of the Galaxy. A rediscussion of Oort's constants of galactic rotation shows that the information they yield concerning the distribution of matter in the Galaxy, while consistent with strong central condensation, does not lead uniquely to such condensation. It may well be, then, that the mass of the Milky Way system resides largely in its outer regions, in which the sun lies. The question then arises, Why should the brightness of a galactic system be so much less in the outer regions than near its nucleus? Can it be that the luminous giant stars occur near the centre while dwarfs tend to preponderate in the outer regions; or is non-luminous dust so widespread round the periphery that it contributes much of the total mass of the Galaxy? These and many other questions of galactic structure must await further observations in happier times.

A. HUNTER.

BRITISH ASSOCIATION CONFERENCE ON MINERAL RESOURCES

THE Conference on Mineral Resources and the Atlantic Charter, held at the London School of Hygiene and Tropical Medicine on July 24–25, was convened by the British Association Division for the Social and International Relations of Science and, like the recent conference on agriculture, owed its origin to suggestions made at the Conference on Science and World Order held last September. The fourth clause of the Atlantic Charter promises equal access on the part of all peoples to the natural resources of the world, and as minerals are among the most important of those resources, it was felt that a survey of the situation might clarify ideas; the general state of information as to the distribution and nature of mineral deposits among the public and even, it is to be feared, in higher quarters, being very imperfect. Coal and oil were excluded from the scope of the discussion as requiring separate treatment. Those who have had occasion to examine questions concerning mineral deposits have been impressed by the unsatisfactory condition of the statistical knowledge about them which is available, in spite of excellent isolated efforts, and for that reason prominence was given to this aspect in the resolution which was put by Sir Stafford Cripps and passed at the end of the Conference. After a preamble referring to the Atlantic Charter, this ran:

"This Conference, having specifically dealt with mineral resources, submits that, as a first step, the Council should initiate forthwith consultations with appropriate scientific and technical organizations, to secure an understanding on the principles involved. The Conference would further urge that a scientific

review of mineral resources, using and supplementing all existing data, should be among the first tasks of any international organization for the social applications of science, such as was envisaged at the recent Conference on Science and World Order. To this end, the Conference recommends that the Council should consider how it might help to promote the establishment of an International Resources Organization, as a fact-finding and advisory body for Governments, as a contribution to world stability, and in the spirit of the Atlantic Charter."

The Conference, which was well attended, was opened by the president of the Association, Sir Richard Gregory, who referred briefly to the new industrial revolution brought about some sixty years ago by the introduction of alloy steels, bringing unfamiliar metals into prominence; metals which are most unequally distributed in the crust of the earth, and thus having special significance in the light of the Atlantic Charter. Sir Thomas Holland, whose presidential address at the South African meeting of the Association first directed attention to the international importance of this irregular distribution of economic minerals and its bearing on preparations for war, then took the chair.

As examples of the questions to be considered, Sir Thomas Holland mentioned that the United States, with its vast steel industry, consuming 750,000 tons of manganese ore in 1937, was unable even with the help of a 100 per cent protective tariff to produce from home sources more than 5 per cent of her own requirements. Germany, also lacking manganese, was tempted by the great resources of South Russia in that metal, perhaps more than by petroleum. Great Britain was almost self-sufficient for the few and simple essential constituents of steel until the last quarter of the nineteenth century, but found itself dependent on distant parts of the Empire and on foreign countries for the alloying elements now needed. Unlike some other natural products, metals cannot be made synthetically for industrial use, and although for certain minor purposes they may be replaced by plastics, they remain indispensable to industry. This dependence necessitates the international exchange of minerals, and if this is to be facilitated, as it must be in a peaceable world, the knowledge of their distribution must be both more complete and more widely diffused.

Prof. H. H. Read, after apologizing to the many geologists present for his elementary treatment of the subject, gave a lucid account of the geological conditions which determine the distribution of mineral deposits. National boundaries have paid little attention to geological regions, and impossible demands for autarky have been made by dictators ignorant of their countries' geology. An autarky based, like that of the U.S.S.R., on a proper estimation of native resources is one thing, and an autarky based on legislation quite another. Even such a wide grouping as that of the United Nations is not completely self-sufficient in minerals, and still less any single country, however extensive.

It was natural that several of the speakers, who had prepared their papers independently, should select the metals used in the production of alloy steels as typical illustrations of irregular distribution. Prof. C. B. Fawcett, speaking of key metals and the location of industry, pointed out that these exceptional elements, such as tungsten, molybdenum and vanadium, are mainly found in the older rocks and for the most part in thinly populated areas. The quantities required are small in proportion to the tonnage of steel produced, and it is also characteristic of them that they pass entirely into the finished product, the loss in manufacture being almost negligible. Many of them occur in such a form that the ores have to be submitted to some kind of concentration before extraction. They are mainly consumed in the regions where heavy industries of the more advanced type are situated; industries employing much skilled labour. These are usually regions of long-established industry, and the gravitation to them of the key metals tends to confirm the existing location of those industries. A dominant fact is that they are essential to the production of armaments and to the making of tools used in that production, so that under existing political conditions no State can feel secure unless it has within its borders a considerable armaments industry. The importance of recovered or scrap metals, dealt with by later speakers, further tends to anchor the highly developed industries to their existing locations.

Prof. P. G. H. Boswell, dealing with the need for better and more complete statistics, reviewed the available sources of information and referred to the lack of uniformity in the definition of available resources. Much information about known resources and estimated reserves is locked up in the archives of mining companies, and it is a question how far this may be made available. An international commission seems to be the only body which could undertake the work after the War, and a useful beginning could be made even now if finance were provided. Exploration has now covered the greater part of the earth's surface, at least so far as the commoner minerals are concerned, but China still affords a vast field for further exploration, while the search for the rarer elements has been far less thorough.

Prof. Boswell concluded with a warning that the diversion of many geologists during the War to other activities, coming after a period in which the number of men being trained in geology was declining, may lead to a serious situation. British geologists have played a leading part in exploration, and many of the leading geologists of other countries have received their training in Great Britain; the lack of appreciation of the importance of the subject, due to ignorance, calls for the attention of educational authorities. After the War, it may be necessary to provide geologists not only for our own needs, but also for loan to countries where scientific training has been interrupted or destroyed. In the course of the discussion it was suggested that geologists might be attached to legations in the lesser-known countries.

The afternoon session on July 24 was presided over by Sir William Larke, who also emphasized the need for a uniform basis for statistics and the fact that in spite of the British lead in scientific discovery and technical achievement, the nation as a whole lacks appreciation of the value of research. The need for continued inter-allied co-operation in this field and in that of economics was stressed. He alluded to the growing importance of the light metals and to the possibility of extracting aluminium from clay, thus rendering the industry less dependent on the very local distribution of bauxite. The high consumption of power in aluminium production would seem to determine the location of the industry, although for reasons partly economic and partly strategic Germany has built up an important aluminium industry based

on electric power generated from brown coal and largely imported bauxite. Like other speakers, he referred to the key nature of the less common metals, large stocks of which had been accumulated by Germany before the War, while no doubt much has been done to conserve those resources by changes in the composition of alloys and in technique.

The remainder of the session was taken up by papers illustrating the general principles by reference to particular metals. Prof. W. R. Jones selected tin, the occurrence of which in useful quantities is confined to a very few regions. The United States consumes 40 per cent of the world's tin, but has not a single tin mine within its borders. Europe provides only 1 per cent of the world's output, this coming mainly from the anciently worked Cornish mines. The alluvial deposits which were the principal source of tin are being rapidly worked out, and we shall in the future be more and more dependent on lode mining. The conditions for the formation of lodes are confined to a few of the older rocks. More efficient concentration of the ores will become important.

Closely allied to the occurrence of tin is that of tungsten, the position of which was outlined by Mr. J. L. F. Vogel. The geological conditions of the deposition of tungsten ores are such that no mining engineer would venture to predict the quantity to be found in a newly discovered deposit. The metal was actually the first to be used in the production of an alloy steel, Mushet having introduced it into his improved tool steel, and it was the main constituent of the high-speed tool steels which attracted so much attention at the Paris Exhibition of 1900. Until 1914 the production of the metal was mainly in Germany, although much of the ore occurs within the British Empire, but since then it has been produced at home.

Manganese ores, which are essential to steel making, were dealt with by Sir Lewis Fermor, who said that whereas manganese is only present in the earth's crust to the extent of 0·10 per cent of the oxide, the ores which are used as its source contain 40 per cent or more of the metal. Of the producers, the U.S.S.R. accounts for well over one-half of the world's supply of almost five million tons, India ranking second. The geographical distribution of this and other economic minerals was illustrated by maps showing the extent of the former continent of Gondwanaland. Ninety per cent of the total production of manganese is consumed in the iron and steel industry, and no satisfactory substitute for it has been found. The paper contained a number of valuable tables, and it was argued, on the basis of statistics of imports and exports, that the Axis countries had no real grievance in respect of supplies of manganese ore. Whereas they produced less than 2 per cent of the total, the pre-war system of international commerce allowed them to secure 26 per cent of the available exports, or 16 per cent of the world's production.

Nickel was discussed by Lieut.-Colonel the Hon. Colin A. Campbell. The greater part of this metal is also consumed in the iron and steel industry, for which it is essential for many purposes, including the stainless steels. Its occurrence is extremely restricted. The first extensive production was from New Caledonia, where it was discovered fifty years ago. The ore, garnierite, is a silicate. The far more extensive deposits of Sudbury, Canada, where the ore is a sulphide associated with copper, were discovered in 1887 and now provide 85 per cent of the total production. The other deposits of the world were reviewed, and even allowing for the opening up of new mines, it seems likely that Canada will account for 80 per cent of the total during our lifetime. The demand is certain to increase as the area of industrially developed countries is widened and their standard of living raised. Its extensive use in armaments gives it high importance in any scheme of sanctions against aggressors.

The last metal dealt with in the session was aluminium, a paper on which was contributed by Mr. M. P. Fogarty. The world output of virgin aluminium was approximately doubled between 1937 and 1941, reaching just under a million tons and it may reach 1,750,000 tons by the end of this year, mainly owing to large extensions in the United States. Secondary aluminium recovered after use is now also an important factor in the industry. The paper dealt largely with the British industry after the War, and contained many statistical data and tables. The utilization of aluminium for civilian purposes has not proceeded so far as might have been expected, but its development is likely to be resumed as soon as the large amount consumed in the aircraft industry is released. An interesting review of new technical methods of utilizing the special qualities of the light alloys was included in the paper.

C. H. DESCH.

(To be continued.)

OBITUARY

Mr. G. C. Lloyd

MR. GEORGE CHRISTOPHER LLOYD, secretary of the Iron and Steel Institute during 1909–33, who died on July 10 at the age of eighty-one, was trained as an engineer, and after completing his apprenticeship spent some years with the Spanish Compañia Transatlantica. He had been at school in Germany, and the knowledge of languages which he gained in his studies and travels was a great asset to him in his later activities.

After a period in a firm of consulting engineers, he joined the staff of the Iron and Steel Institute as assistant to the secretary, but four years later left to become secretary of the Institution of Electrical Engineers. On the death of Mr. Bennett H. Brough he returned to the Iron and Steel Institute, which he served efficiently and devotedly for twenty-four years. Through the foreign meetings of the Institute he made friends among the metallurgists of many countries and was associated as secretary with several international congresses, being a vice-president of the International Association for Testing Materials. His services in this field were recognized by the conferment on him of the Swedish Order of the North Star and of the French Legion of Honour.

In 1915 he was also appointed secretary of the Statistical Bureau of the Iron, Steel and Allied Trades Federation, and for several years was responsible for the collection of statistics and their incorporation into an annual report. In 1918, at the instance of the Advisory Council for Scientific and Industrial Research, he prepared the first edition of a report on the sources and production of iron and other metalliferous ores used in the iron and steel industries of the United Kingdom.

To metallurgists in Great Britain and abroad Mr. Lloyd's knowledge, courtesy and kindliness were well known; to the staff of the Iron and Steel Institute he was a valued friend.

NEWS and VIEWS

Soil-less Cultivation

A REVIEW of the recent progress in soil-less cultivation has recently been given by Prof. R. H. Stoughton (*J. Min. Agric.*, 49, 25; 1942). In spite of many misconceptions and difficulties, steady progress has been made both in the laboratory and on small-scale semi-commercial installations, and a stage appears to have been reached when some reliable judgment can be formed on the question. Two types of systems are in use: (1) in which the plants are grown in a tank of nutrient solution with the roots immersed in a liquid medium; (2) where the permanent substratum is an inert material such as sand or gravel, to which nutrient solution is supplied at intervals. Carefully controlled trials have shown that in general the first of these is unsuitable for use in Great Britain, owing to the difficulty of securing adequate aeration for the roots, and the low light intensity. Far more promising results have been obtained with the second method, which may be considered under two main headings, namely, sand and sub-irrigation culture. In sand culture the plants are fed by watering on the nutrient solution from above, the surplus liquid draining away. Tomatoes, chrysanthemums, lettuce and a wide range of vegetables gave very satisfactory crops under these conditions, and promising results have been obtained with carnations using a slightly modified and simplified technique.

The disadvantages of the system, however, are the care needed in the control of the moisture content of the medium, and wastage of materials through drainage, but these are to some extent offset by the small cost of the outlay compared with the sub-irrigation method. In the latter case, the nutrient solution is pumped at intervals from below into the growing-tank until the gravel is flooded to the top, the pump is then shut off and the liquid flows back by gravity to the supply tank. The watering and feeding can thus be made almost automatic, the aeration of the medium is excellent and considerable economy in fertilizer materials is effected. Further, chemical sterilization of the gravel is easily carried out. To meet the criticism that soil-less cultivation results in crops of lower nutritional value, chemical analysis of the carbohydrate, protein, inorganic constituents and vitamin C content were carried out. No significant differences could be established between plants grown in gravel and those grown in soil. Experiments are now in progress at the University of Reading, under a grant from the British Electrical and Allied Industries Research Association, to test, among other things, the effect of heating the solution in the sub-irrigation culture of tomatoes. Work is also proceeding on the chemical testing of the solution by simple colour tests, so that its composition may be readily controlled according to the requirements of the crops.

American Newspaper Reporting of Science News

A REVIEW with this title by Hillier Krieghbaum has been published in the *Kansas State College Bulletin* (25, No. 5, Aug. 15, 1941; pp. 1–73); it is the sixteenth in a series of surveys of specialized branches of journalism. The beginnings of newspaper science reporting are traced: there was little interest among the early colonists, but as communities stabilized the outlook of editors grew. Benjamin Franklin could write with authority on science, but more usually items were reprints or grossly misinformed, and coverage was spasmodic. In the 1830's there occurred the rise of the penny Press and stunts and hoaxes became common; but editors were sceptical about the Atlantic cable, and Darwin's theory of evolution was barely mentioned. Again, in 1903, very few newspapers noted the first flight of the Wright Brothers. The section of the American Press led by Hearst and Pulitzer began, at the turn of the century, to search more widely for news sensations, but a fuller appreciation of science as news had to come through the War of 1914–18. E. W. Scripps was a pioneer in encouraging specialist writers for the Press, and it was his *New York Times* that was alone in publishing in 1919 an accurate story on the implications of the confirmation of Einstein's theory of relativity. In 1922 several writers attended the annual meeting of the American Association and one of them received a Pulitzer Prize for his work.

Scripps' interest in science led to the foundation and endowment of Science Service, formally known as the "American Society for the Dissemination of Science", launched in 1921 with the co-operation of three of the national scientific organizations. It was to be composed exclusively of men of science, with a layman journalist as editor; while not intended to be run at a profit, a fair charge for its services was to be made. Trustees were selected from the scientific bodies, the journalistic profession and the Scripps Estate. The first weekly issue of *Science News Bulletin* appeared in April 1921, edited by Dr. E. E. Slosson. To-day it is published for the general public as *Science News Letter*, and for the Press and radio there are syndicated news and features services; the director is Watson Davis, a member of the organization since its foundation. A technique was developed of writing stories for future release from advance information, and these are supplemented by regular articles by specialists. In 1941 the daily newspapers served in the United States reached eight million subscribers, with another million abroad before the present War. Science Service has aimed at being a liaison agency between the scientific world and the general public.

Scientific workers have felt in the past some antagonism—often justifiably—towards newspapermen: the independent scientific journalists of experience realized this and in 1934 formed in the United States the National Association of Science Writers, which now has twenty-eight members. The Association works with organizers of scientific conferences, and usually receives special facilities for advance information and 'off the record' talks. It is a mark of the success of the Association that in 1937 several of its members shared the Pulitzer Prize for reporting. To-day many of the large research laboratories and industrial organizations themselves issue material to the general Press. The 'science column' has become a permanent feature of many of the leading American newspapers, with additional activity in the fields of broadcasting and films, and a high standard of accuracy is maintained.

Early Astronomy in South America

IN Leaflet No. 159 (May 1942) of the Astronomical Society of the Pacific, Roscoe F. Sanford gives a brief account of early astronomy in South America. Our knowledge of the subject results from a number

of expeditions which were sent from the United States with the object of securing data on various astronomical matters. In 1847 Lieut. J. M. Gilliss, founder of the U.S. Naval Observatory, induced Congress to authorize and finance an expedition to South America to improve the value of the solar parallax. Cerro Santa Lucia in Chile was chosen as the site for the observatory, and great progress was made in the next three years, during which the positions of Mars and Venus were determined simultaneously in Chile and in the United States, mostly at Cambridge. Several years later, the reduction of these observations was carried out and a solar parallax of 8·5″ was derived. Research was conducted in other directions, and eventually the Chilean Government became so interested in the work that it arranged for young Chileans to be taught the use of the instruments. Later it purchased these and founded a National Observatory. Dr. Benjamin Gould, who had carried out the reductions for the solar parallax, interested Sarmiento, the Argentine ambassador to the United States, in a scheme for determining accurate star positions in a zone where observations were lacking, and the result was that the Argentine Government founded El Observatorio Nacional de Argentina in 1870, Gould being chosen as director.

Among other projects in South America, reference is made to another Argentine observatory, built at San Luis, through the influence of Prof. Lewis Boss, director of the Dudley Observatory in Albany, New York. This Observatory obtained a total of 85,000 star positions between 1909 and 1911. Before this, so early as 1890, Prof. S. I. Bailey established a station for the Harvard College Observatory in Arequipa, Peru; this was transferred to South Africa in 1926. In 1903 Prof. W. H. Wright established a station on Cerro San Christobal on the outskirts of Santiago for determining radial velocities. This station was known as the D. O. Mills Expedition of the Lick Observatory, and when the work was completed, the equipment was sold for a nominal price to the Catholic University of Chile. These and other astronomical ventures have established creditable cultural relations and lasting good-will between races with differences in customs, aspirations, and mode of thought, and have led to a better understanding of both scientific and political problems.

Origin of Meteorites

H. H. MININGER, Colorado Museum of Natural History, in a paper entitled "Trends in Meteoritics" (*Sky and Telescope*, **1**, 8; June, 1942), gives a short résumé of our knowledge of meteorites. Most hypotheses in the past regarding the origin of these bodies gave more attention to iron than to stone meteorites, and erroneous conclusions were drawn. Chondrules, the most abundant of all meteoric constituents, have almost certainly been formed by repeated collisions between crystals and other solid bodies. For this reason, a situation which would provide for the rounding of crystals into chondrules would also produce the fragmentary matrix in which chondrules are usually embedded. It is suggested that in the past, when the sun was more active, extruded gases crystallized and collected into cometary swarms and within these swarms chondrules were produced by repeated collisions, while the aggregation of the resulting fragments and chondrules gave rise to meteorites. Some of the cometary swarms passed close enough to the sun to allow for the fusing of a percentage of the constituent grains, and this process was carried almost to the point of completely fusing the mass in the Lubbock aerolite, which was described in the *American Mineralogist* (**25**, 528–33; 1940).

It is surprising to learn that a considerable proportion of stony material which enters our atmosphere is reduced to dust. Dr. Lincoln La Paz has estimated that the Pasamonte meteorite weighed 66,000 tons at least when it entered the atmosphere, but only 4,000 gm. were collected. A huge dust cloud occupying about 1,000 cubic miles accounted for the principal mass of this meteorite. Further research on meteors may well yield useful information on the past history of the solar system.

The Beet Leafhopper

THIS insect, known scientifically as *Eutettix tenella*, forms the subject of Farmer's Bulletin No. 1886 (1941) of the U.S. Department of Agriculture, by W. C. Cook. We note in this publication a markedly enlarged dimension of its pages as compared with the usual run of its predecessors. Its value is thus enhanced by allowing of larger scale and more detailed illustrations and of a more convenient spacing of the letterpress. The beet leafhopper is native to the western United States and to northern Mexico, and is notorious as the carrier and transmitter of the virus of the destructive curly top disease of sugar beet and also of western yellow blight of tomatoes. During many years past the curly top disease has been a major factor limiting the production of sugar beet in many western areas. The whole problem of its control is a difficult one since direct spraying is rarely of value. In many areas the control of grazing is the most feasible method of attacking many of the plant hosts of this insect. In some cases reduction or elimination of the Russian-thistle, the most important summer host, by mechanical means is possible. The actual status of the natural enemies of the leafhopper is difficult to assess, but they are considered to be of great importance. The most notable are flies of the family Pipunculidæ and parasitic wasps of the Dryinidæ group. Predacious bugs, one of which is *Geocoris pallens*, are said to be of equal importance as parasites in reducing its numbers. The development and successful production of strains of beet resistant to the curly top disease has greatly reduced the losses incurred by the spread of the virus disease. By this means the cultivation of sugar beet has been made possible in districts formerly found to be unsuitable.

Earthquakes Registered in Switzerland

ACCORDING to bulletins just received concerning earthquakes registered at the observatories of Zurich, Basle, Neuchâtel and Chur, fifteen earthquakes were consistently registered during February 1942 and nine strong earthquakes during March. Many of these have been mentioned previously in the columns of NATURE, but epicentres on the European continent can now be given. On February 6 an earthquake recorded at Zurich at 00h. 10m. 46·6s. had its epicentre in the Rheintalgraben to the south of Freiburg. On February 7 an earthquake recorded at Zurich at 03h. 55m. 41·4s. had its epicentre near Venice. This was strongly recorded at all the stations. On February 12 an earthquake registered at Zurich at 16h. 03m. 17·5s. had its

epicentre east of the Pelvoux-Massiv, in the Westalpen. This shock also was strongly recorded at all observatories. On February 17 an earthquake with its epicentre between Simmental and Kandertal in the Berneroberland was strongly recorded at all stations, the recording at Zurich being at 11h. 14m. 58·8s. On February 22 an earthquake recorded at Zurich at 22h. 34m. 38·8s. had its epicentre near the Stuttgart Rheintalgraben. The earthquake of February 28 (Zurich, 13h. 49m. 13·4s.) had its epicentre in the Bodenunruhe, and that of March 15 (Neuchâtel, 16h. 06m. 27·8s.) its epicentre to the south-east of the Neuenburgersee.

During April and May, 1942, thirty-one strong earthquakes were registered by the seismographs at the Swiss Observatories of Zurich, Basel, Neuchâtel and Chur, according to bulletins just received from Zurich. One epicentre, not mentioned previously in the columns of NATURE, is for the earthquake of April 12. The shock was recorded at Zurich at 00h. 02m. 53·9 U.T. and apparently came from an epicentre 420 km. distant. This epicentre is most likely to have been in the Udine Province of Italy.

Trachoma in the Argentine

ACCORDING to the April issue of the *Boletin de la Medicina Sanitaria Panamericana*, the provinces of Tucumán, Santiago del Estero, Santa Fé, Entre Rios, Corrientes, Salta, Jujuy and Misiones form the area most seriously affected by trachoma in the Argentine. The school is the centre for the control of the disease in children; specially trained doctors examine the children before school begins, and those found infective are given treatment in dispensaries and are not admitted to school until their eyes are normal. Meanwhile, the patients are visited by public health nurses, who instruct the family in treatment and prevention. Periodic visits to schools and dispensaries are made by medical inspectors of the National Department of Health, and teachers serve as intermediaries between the medical practitioner and the children. Intensive educational work is carried out by posters, leaflets and lectures, and preventive medicines are distributed. The result of this campaign during the last few years has been a reduction of the percentage of children infected with trachoma.

Yellow Fever in the Americas

IN a recent paper (*Bol. Of. San. Panamericana*, **21**, 320; 1942), Dr. Wilbur A. Sawyer, director of the Division of International Health, Rockefeller Foundation, New York, discusses the following features of the yellow fever situation in South America: (1) the absence of a definite outbreak of urban yellow fever transmitted by *A. ægypti*; (2) the absence of yellow fever of any type recognized outside South America; (3) the presence of jungle yellow fever, which takes the form of endemics, or epidemics spread over wide areas of South America. The chief features of control methods consist in weekly inspection of premises for *A. ægypti* larvæ, destruction of breeding-places and search for other mosquitoes by special squads. While cities may be kept free from infection by *A. ægypti* control, vaccination is the only measure practicable against jungle yellow fever; it can be carried out on a large scale and has been found both safe and effective.

Oil-bearing Plants in Sweden

ACCORDING to the June issue of the *Anglo-Swedish Review*, the cultivation of oil-bearing plants in Sweden has developed rapidly. In 1940 the area covered by such plants was only 938 acres, whereas in 1941 it was 21,250 acres, yielding a harvest of 10,000 tons of seed from which 2,700 tons of oil could be produced and 7,000 tons of fodder. This year it is established that the oil plant area is 42,500 or 45,000 acres, out of which 5,000 acres is rape, 32,500 acres white mustard, 1,000 acres poppy seed and 2,500 linseed. The yield will be at least 20,000 tons of seed, from which 6,000 tons of oil can be extracted, representing a little more than one tenth of the normal consumption of margarine in Sweden. It is considered likely that the cultivation of oil plants will be so extended that it will be possible to cover one fourth of the normal requirements of raw material for the manufacture of margarine.

University of London

THE following appointments have been made in the University of London: Dr. F. G. Young, since 1936 a member of the scientific staff of the Medical Research Council, to the University chair of biochemistry tenable at St. Thomas's Hospital Medical School; Mr. B. W. Windeyer, medical officer in charge of the Meyerstein Institute of Radiotherapy, Middlesex Hospital, to the University chair of radiology tenable at Middlesex Hospital Medical School; Dr. Alexander Lawson, lecturer in chemistry at University College, Southampton, to the University readership in organic chemistry tenable at the London (R.F.H.) School of Medicine for Women.

The title of reader in education in the University has been conferred on Mr. J. A. Lauwerys in respect of the post held by him at the Institute of Education.

Announcements

SIR GUY MARSHALL has resigned from the directorship of the Imperial Institute of Entomology. He is succeeded by Dr. S. A. Neave, who has been assistant director since 1913.

SIR LOUIS STERLING has been elected president of the British Institution of Radio Engineers in succession to Dr. C. C. Garrard. The presidential address, which is expected to deal with registration of engineers, will be read before the London Section of the Institution at a meeting to be held at the Federation of British Industries, 21 Tothill Street, Westminster, S.W.1, on September 25.

APPLICATIONS for the conditions of the competition for the Jones-Bateman Cup, offered triennially for original research in fruit culture which has added to our knowledge of cultivation, genetics, or other relative matters, may be had on application to the Secretary, Royal Horticultural Society, Vincent Square, Westminster, London, S.W.1.

ERRATA. "Relationships of some Primitive Tetrapods", by Dr. T. S. Westoll (NATURE, July 25, p. 121): paragraph 2, line 4, for "Burdie-house" read "Burdiehouse"; paragraph 4, line 3, should read "... strata of latest Dinantian (Viséan) and Namurian age. . . ."

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. No notice is taken of anonymous communications.

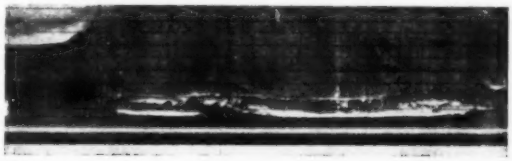
Holes in the Ionosphere and Magnetic Storms

THERE is good reason to attribute magnetic storms to neutral streams from the sun. These streams have equal numbers of positive and negative ions, because any excess would immediately be dissipated into the surrounding space.

The purpose of the present communication is to suggest, and put upon record, another effect of such streams which is supported by considerable evidence. When a neutral cloud enters the ionosphere, the electrons are brought to a standstill much sooner than the positive ions. Massey and Smith[1] have shown that, at cloud speeds of the order of 10^8 cm./per sec., the percentage energy loss in inelastic collisions for protons, a loss which would reduce their range, is negligible compared with that for electrons, and that the elastic collisions scarcely deviate the proton stream at all. The result is that, under proper conditions, the positive ions in the faster streams penetrate to the *E* layer, leaving the electrons in the higher regions. There is then a large electric force between the *E* and the *F* layers, and this electric force, together with the horizontal component of the earth's magnetic field, produces a violent drift of all the electrified particles in the *F* layer. The electrons which are in excess, and the positive ions, move from east to west and produce an effective west-to-east current in the upper layer. The opposite movement is produced in the *E*, or lower layer, but large mass movements are prevented because of the large molecular density there. If the neutral stream is local, the ionosphere is swept fairly clear of negative electrons and positive ions, and a big hole is produced. This may account for the very large reduction in the ionic content of the *F* layer during magnetic storms. Experiments have indicated that such large reductions do occur, and that these are sometimes much larger than the dilutions which would be produced by the heating of the upper atmosphere, a process which is entirely inadequate to account for the whole effect observed in certain cases. The accompanying illustration is from a photographic record of the 'hole' production during a magnetic storm.

The results obtained by Berkner, Wells and Seaton[2] on ionospheric effects associated with magnetic disturbances show that a hole is produced in the ionosphere at Huancayo at exactly the time that a magnetic storm starts (April 16, 1938). A little later in the progress of the storm, probably when the higher speed particles arrive, a sudden ionization is produced in the *E* layer. The whole sequence of the events observed at Huancayo can be completely explained in terms of this theory, and the statistical result that practically all magnetic storms are associated with a reduction in the *F* layer density is also explained.

This hole production is substantiated by a great deal of evidence. The electrons in the *F* layer and positive ions in the *E* layer move in such directions as to increase the horizontal magnetic field during a magnetic storm, and this corresponds with the normal first phase of such a storm. It has been suggested that no very marked effect will be produced because the electrons will spiral down the direction of the earth's magnetic field, and recombine at once with the positive ions, but it must be remembered that, as well as this spiral, there is a drift of the electrons from east to west in the upper layer, so that these may be removed far from the positive ions, which drift in the opposite direction before they can recombine. An appreciable increase of the magnetic field will obviously occur. What its amount is depends on the density of electrical particles in the stream. No exact numerical computation of this field increase can be made until this factor is known, but reasonable stream densities give reasonable increases of *H*. Thus, in a rough calculation, a stream with only 40 ions per c.c. will produce in a few seconds a field of 10 v./cm. with a drift velocity of 10 cm./sec. and an increase in *H* of the order of 100 γ.



21.30 21.45 22.00

Local time (hr.)

Height of layer increases from bottom of record.

Although this theory, so far as it is associated with magnetic storms, needs a numerical backing, there can be no doubt about its effect in producing holes in the ionosphere. Much remains to be calculated, and the second phase of the storm may perhaps be associated with the drift of the electrons towards the positive ions, where they recombine. There is, no doubt, a magnetic storm effect as described in the ring production of Prof. S. Chapman. What is the relative importance of these two I do not know. But at least the mass movements of the electrons and their effective magnetic changes should be computed, and a critical analysis made to see if such mass movements can produce the effects observed in magnetic storms.

T. L. ECKERSLEY.
Marconi's Wireless Telegraph Co. Ltd.,
July 16.

[1] *Proc. Roy. Soc.*, A, **140**, 486, 142–272 (1933).
[2] *Ter. Mag. and Atmos. Elec.*, **44**, No. 3 (Sept., 1939).

Biotin, B_1, Riboflavin, Nicotinic Acid, B_6 and Pantothenic Acid as Growth Factors for Insects

WE have already stated[1] that biotin is very likely a growth factor for the flour beetle *Tribolium confusum*. Growth of the larva is very much better on a diet consisting of casein, glucose, yeast, cholesterol, salts and water than when yeast is replaced by yeast extract (Table 1, 1). Normal growth is restored by adding the water-insoluble fraction of yeast[2]. All our previously reported experiments indicated that the missing factor in the yeast extract diet was biotin. Since then we have had the opportunity of testing first the most powerful concentrate of biotin then on the market ('Smaco'), and later pure biotin methyl ester ('Smaco'). It was found that both the concentrate (3) and the pure substance (4) improved

very strikingly the efficiency of the diet which contained yeast extract instead of yeast.

TABLE 1. Basal diet: 50 parts casein, 50 parts glucose, 1 part cholesterol, 1 part McCollum's salt mixture and 15 parts yeast extract. Twenty larvæ in each test. Temperature 25° C. Relative humidity 70 per cent.

Additions to basal diet.	Period in days during which the first 10 pupæ were formed.
(1) none	39–48
(2) Insoluble yeast	28–30
(3) biotin concentrate	28–31
(4) biotin methyl ester	
3·75 γ gm. dry food	39–48
1·25 ,, ,, ,,	38–42
0·5 ,, ,, ,,	32–40
0·25 ,, ,, ,,	29–36
0·0625 ,, ,, ,,	30–36

The lowest two concentrations of biotin methyl ester used produced about the same effect, which is apparently the optimum. Larger quantities seem to be poisonous. It is, however, just possible that this poisonous effect was due to insufficient removal of the alcohol in which biotin methyl ester was dissolved. Since 0·25 and 0·0625 γ/gm. produced about the same effect, it is likely that the minimum quantities required for optimum effect might be lower still. As has been reported before for rats, yeast and other micro-organisms, the quantities of biotin required are exceedingly small, and many times smaller than those reported for other vitamins.

The availability of most of the members of the vitamin B group in pure substance made possible an attempt to grow Tribolium on a diet in which all the water-soluble B vitamins are supplied in pure form. By leaving out one vitamin at a time it was possible to establish which of the vitamins of the B group are essential growth factors for Tribolium (Table 2).

TABLE 2. Diet: 50 parts casein, 50 parts glucose, 1 part cholesterol, 5 parts insoluble yeast, 1 part wheat germ oil, 1 part McCollum's salt mixture and 15 parts water. Vitamin B_1, riboflavin, nicotinic acid, B_6, pantothenic acid, choline chloride, *p*-amino-benzoic acid (all used at the rate of 50 γ/gm. dry food). Twenty larvæ in each test. Temperature 25° C. Relative humidity 70 per cent.

	Period in days during which the first 10 pupæ were formed.
Whole diet	38–43
Diet without *p*-amino-benzoic acid	36–42
,, without choline chloride	38–43
,, without B_1	40–57
,, without pantothenic acid	50–61
,, without riboflavin ,, without nicotinic acid ,, without B_6	no pupæ; after 105 days most larvæ have died
Yeast extract instead of pure vitamins	28–30

From this series it appears that Tribolium does well without choline chloride and *p*-amino-benzoic acid. Without B_1 or pantothenic acid, growth is very considerably slowed down, and without riboflavin, nicotinic acid or B_6 growth comes almost to a standstill. This proves that at least these five vitamins of the B group are necessary growth factors, which is essentially in agreement with recent findings concerning the vitamin requirements of Drosophila[2] and mosquito[3] larvæ. But it does not prove that the two other substances are not necessary, or that the three substances without which no growth occurred are more essential than the two on which slow growth was possible. The diet contained the water-insoluble fraction of yeast, and we do not know what amounts of soluble factors this preparation might still have contained.

It will be noted that growth on the diet containing all the vitamins in a pure state is still considerably slower than when a yeast extract was supplied instead (Table 2). Similarly, a diet which contained the apparently optimum amount of biotin is still noticeably worse than one which contains insoluble yeast instead (Table 1). This indicates that, as was to be expected, there are still other growth factors contained both in the yeast extract and the insoluble yeast.

We wish to express our thanks to the Royal Society for a Government grant which made this investigation possible, to Dr. J. H. Sang for a gift of the biotin concentrate, to Mr. A. L. Bacharach (Glaxo Laboratories) for the gift of samples of vitamin B_6 and pantothenic acid, and to Roche Products, Ltd., for a gift of pantothenic acid.

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July 2.

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Steric Promotions and Inhibitions of Polarizations

EXCEPTION is taken to the statement[1], "These new results appear to confirm the suggestion made in the Annual Reports for 1939 that the various manifestations of the 'ortho-effect' cannot be interpreted on the basis of a single conception". The *new* results are in complete accord with the ideas expressed in my earlier communication[2]. This letter pointed out that polarizations can be *promoted* as well as inhibited by steric congestion, and the data of R. D. Kleine, F. H. Westheimer and G. W. Wheland[3] offer an excellent example of both.

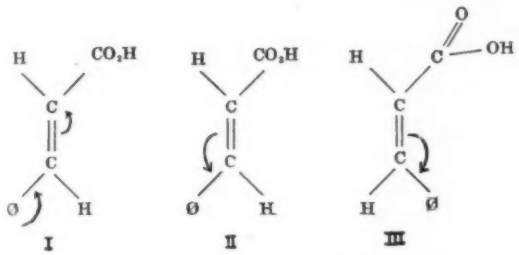
The dissociation constant of acrylic acid is not much greater than that of trans-cinnamic acid[4], and polarization represented by formula I can be only slightly more developed than that represented by II.

Collision between nucleus and carboxyl group in cis-cinnamic acid produces a torque in the ethylenic linkage which decreases the degree of double bonding; however, this collision occurs at the oxygen atoms and in a direction (perpendicular to the plane of the C-C-O atoms) producing, together with a torque in the ethylenic linkage, an orientation of the carboxyl group (as shown in III) unfavourable to the polarization which develops greater electron density in the neighbourhood of the carboxyl group. In consequence, the polarization shown in III is preferentially developed and the dissociation constant is greater than that of the trans-isomeride. This polarization is augmented by the methyl group in cis-α-methylcinnamic acid and the dissociation constant is correspondingly increased.

The torque in the ethylenic linkage of trans-α-methylcinnamic acid is produced by the collision of the methyl group with the nucleus, and the weakening of the double bond can be utilized by a suitably oriented carboxyl group (as illustrated by IV) to produce a low dissociation constant. Again, the methyl groups of cis-2 : 4 : 6-trimethylcinnamic acid do *not* orient the carboxyl group out of the plane which

includes the carbon atoms embracing the ethylenic linkage; consequently, the dissociation constant of this acid is lower than that of the trans-isomeride.

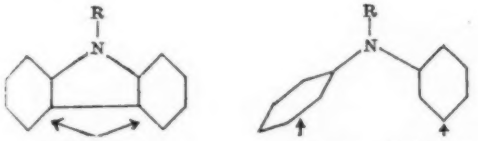
Although the benzene ring has a high reactivity in both *N*-methylindoline and *N*-methyltetrahydroquinoline, only derivatives of the latter can exhibit inhibited mesomerism. For example, one can safely predict that the introduction of a methyl group into the 8-position of the latter will have a depressing



I II III IV V

effect on the behaviour of the benzene ring towards electrophilic reagents, an effect which will not be realized by the introduction of a methyl group into the corresponding position of the former. Work in these laboratories has shown that whereas 5 : 8-dimethyl-α-tetralone isomerizes to the 5 : 7-isomeride in the presence of aluminium chloride and hydrolyses to γ-(2 : 5-dimethylphenyl) butyric acid with phosphoric acid, 4 : 7-dimethyl-α-hydrindone cannot react in either of these ways. These differences reveal that, in the α-tetralone homologue, ring puckering can allow steric conditions to inhibit the mesomeric effect of the carbonyl group and promote a nuclear polarization represented by V in which the carbonyl carbon atom is deflected out of the plane of the benzene ring.

Finally, there should be little difficulty in interpreting the lower reactivity (towards deuteration) of carbazole derivatives relative to the corresponding diphenylamine derivatives; only in the latter, as illustrated, can suitable orientation allow of a high reactivity.



partially reactive unreactive highly reactive

The closing of one channel so as to obtain the maximum effect down a second channel was exemplified in my earlier communication[2] by "the abnormally slow alkaline hydrolysis of *o*-relative to *m*- and *p*-acettoluides".

I would like to take this opportunity to express my indebtedness to Prof. J. Kenner for the interest he has taken in the development of these ideas and the encouragement he has always offered me.

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Science, Politics and Service

THE contribution of science to the planning of society and particularly to the shaping of its own opportunities seems to be in considerable part confused by a division of many men of science into two contending elements which are essentially parallel with political factions, though perhaps not always conscious of these allegiances.

A key point at issue is the advisability or inadvisability of State control, that is, whether the works of science are to be centrally organized or left solely to individual initiative, and the gulf between these two views is widened by the opposition of the political impulses of many of their respective adherents. A solution of this *impasse* is obtained by clearly recognizing the need both for organized and for individual development. No one will deny that research in biological and social subjects, and perhaps in others, requires expansion by governmental action and also co-ordinating direction towards the most immediate problems; while the present level of independently undertaken research could be preserved, the work of the limbs of the State-aided scheme could be directed by committees composed of representatives elected by the Government, by scientific societies and by the various research departments, academic and other. Full scope would then be accorded to creative originality, while the nation would also profit from direct contributions by all available experts to its urgent problems; the result would be implementation of common desires, and not loss of freedom. A prime aim of science being to educate and advise, but not to administer, outside its own sphere of working, co-operation with Governments in schemes of research and development would give place for a helpful influence on statesmen.

While many differences in opinion among men of science are a sign of vigour and independence, none the less serious rifts in policy through allegiances to non-scientific causes are likely to be harmful. The growing need for scientists to educate and inform the general public and politicians could not be fulfilled if substantial support had been shown to any one particular faction as a display of personal inclinations, or less personally, to court favours from the apparently more promising source. Politicians are more fickle and self-centred than men of our tradition, it is to be feared and hoped; and also with parties losing or retaining power unpredictably, the financial axe would ever threaten to be used as an excuse to cut down or withhold the schemes urged by the supporters of former Governments or other parties. Expression in active politics seems suitable for the man of science only in his single and private capacity as a citizen; it is not a function of or a benefit to the way of science, and it would enrage just as much as engage attention. The use of the cause of science to give support to the cause of some political party is quite imaginable, though any such confusion, or linkage of causes would be wholly reprehensible.

Men of science, politicians and the various groups of the public largely limit the application of their minds to channels so distinct that their view-points lack sympathetic knowledge each of the others. Unity and power of presentation of policies are therefore essential. Science has often excessively suffered by lack of appreciation of its purposes or by the occasionally misguided zeal of its devotees, and evidence for this misunderstanding need be sought no further than in the sphere of religion.

The duty of men of science is clearly to avoid incrimination of science in party politics but to seek a commonly agreed belief and policy, so far as is humanly possible, for science in general and the sciences in particular, which they would severally labour to enlarge and which they would suitably impress on the non-scientific world with greater force and penetration than are at present employed.

While planning for international collaboration and admiration for the achievements of certain other countries are eminently commendable, the existence of strong elements in Britain, America and elsewhere neither similarly inspired nor likely to be converted by reasoned disquisitions should induce a practical note of not untimely caution. These other countries enjoy great national prides and ambitions, each in its own way; and the British Commonwealth of Nations, realizing that they themselves must play an undeviatingly strenuous part in pressing world peace, will prove their virility and capability for such leadership by assuring their own prosperity, power and honour. Through incomplete understanding of our history, the rallying call of 'Britain and Empire' has become one almost for abuse, though, national prides and sectional urges being what they are and will for long remain, it is essential as a preventive against factious disintegration and as a prerequisite of a still wider well-being. Men of science in the British Commonwealth of Nations should play no small part in fostering all that redounds to the prosperity and glory of Britain and Empire, so helping to draw together the impulses of a great variety of people with advantage for understanding and action in other directions, not the least being appreciation of the full material and social benefits obtainable from science.

Recognition of the beneficial power of our national pride is not shallow nationalism but a reasoned feature of politico-sociology resulting from the observation, as any competent journalist knows, that the great majority of people are reached only through their emotions. Indeed, men of intellectual attainments are in little better straits and their views are very diverse and often antagonistic, so that no reason exists for not seeking and integrating common national traits to serve as a springboard for further progress. Too frequently an active common spirit in the country is promised, somewhat optimistically or alluringly (or even threateningly, as a *sine qua non*), to result only from extensive schemes of reorganization; this spirit of service and fellowship should be engendered now, not only to assist the war effort but also for peace and to prepare for those changes of organization that the country may choose in the course of time. Propaganda—a word denuded of evil if the weight of science and culture were behind it—would here prove of great value for both the present and the future.

It is a tragedy for Great Britain that the valuable qualities of scepticism and individualism among its inhabitants tend to deprive them of the intense love of country and the virility so much needed for strength and progress in these decades when this essentially commercial country is facing both wars and growing competition in the world of industry.

JOHN PETRIE.

Universities in War-time

SURELY the article on "Universities in War-time" in NATURE of July 25, p. 97, omits to mention the most powerful of all motives which impel men to thought and to action at such a time as this and whether they are in a university or in the Fighting Forces; nowhere is 'love of country' or patriotism mentioned. Our lost capacity for moral indignation is lamented; I would rather rejoice over the fact that our sense of patriotism is bright and burning as of old. To mark the fate which meantime has overwhelmed France seems to me to supply an infinitely more powerful incentive to endeavour than the fear of a twilight falling on our "moral standards and spiritual values".

There is another omission of even greater import. Nowhere is it made clear to readers that when a nation passes from a state of peace to one of war, it has to scrap not only its peace-time economics but also, so far as the enemy is concerned, its peace-time code of "moral standards and spiritual values"; to refuse to do so would ensure its speedy defeat. Germany passed from a peace to a war footing in 1933; we are now at the stage which Germany reached about 1936. German universities were bound to the war chariot at an early stage; ours are still free, long may they be so!

Civilization is defined as "self-discipline", its advance measured "by man's gradual mastery of his more savage instincts". Whether we like it or not, in war we must confront the enemy with the heart of a savage and with a head fortified by all the cunning which civilization can give it. Germans had to give up their individual liberties in 1933; ours have to go now. Will we—or for that matter our enemies—get them back when peace comes? That depends upon what use Germany makes of peace rather than upon our wishes.

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An Undescribed Stage of Sarcotaces

THE systematic position of the genus Sarcotaces, according to Calman[1], is quite obscure, for as a result of the extreme degeneration shown by the parasite most of the characteristic features have disappeared. Although *S. arcticus* is not infrequent in the blue ling, *Molva abyssorum*, appearing as dark oval-shaped cysts lying among the myotomes of the lateral line, it has only been very briefly referred to by Collett[2] and Hjort[3], who suggested that it was a Cirripede. Two other species have been recorded, *S. verrucosus* by Olsson (1873)[4] from Acanthurus in the West Indies, and *S. pacificus* from Antennarius at Misaki, Japan, by Komai[4], who suggested that it belonged to the Copepoda.

In all three species the only stages described are the adult female, which occurs in the ovoid cysts of the lateral line and in the case of *S. arcticus* reaches the dimensions of 55 mm. in length by 25 mm. in diameter, and the nauplius, which can usually be

found in the space between the female and the cyst wall.

Through the kindness of Dr. R. S. Clark and Prof. Edward Hindle, I have had the opportunity of re-examining cysts of *Sarcotaces arcticus* found in blue ling landed at Aberdeen, and found what seems to be the male form of this parasite.

A total of twenty-six cysts was examined, all of which contained ova and nauplii in addition to the adult female, and in nineteen of them a hitherto undescribed stage was found, shown in Figs. 1 and 2. The numbers present in each cyst varied from one to four; they were always found attached to the cyst wall by their ventral surfaces. Their dimensions never exceeded 3 mm. in length, exclusive of the caudal furca, 0·6 mm. in breadth, and 0·2 mm. in thickness. The anterior part is expanded to form a triangle, ending in a small head (Fig. 2). Slight constrictions seem to indicate segmentation, and there are a number of pairs of vestigial appendages. The head bears four pairs of appendages, antennules, antennæ, mandibles and postoral appendages which may be small maxillules or maxillæ.

The ventral surface of the expanded triangular part of the trunk bears two pairs of biramous appendages, and along the length of the body are one or two pairs of hook-like appendages. The telson bears a caudal furca, which is very variable in size.

The mouth leads directly into the alimentary sac, which like that of the female ends blindly and contains a dense black substance probably derived from the blood pigments of the host. Behind the gut are

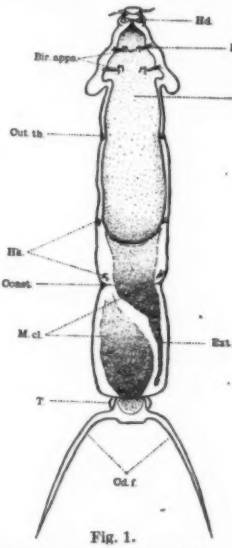

Fig. 1.

VENTRAL ASPECT OF SMALL PARASITE FROM CYST OF *S. arcticus*.

Al. tr., alimentary tract; Bir. apps., biramous appendages; Cd. f., caudal furca; Cut. th., cuticular thickenings; Const., constriction of trunk; Hd., "head"; Hk., hooks; M.cl., cell masses (testes?); Mu. b., muscle band; T. telson; Ext., posterior extension of cell mass.

two masses of densely staining tissue suggesting testes, but the material was not sufficiently well preserved to identify the nature of the cells. Although there was a suggestion of a genital duct leading from these organs, no external aperture could be detected.

There can be no reasonable doubt that these parasites represent a stage in the life-cycle of Sarcotaces. It is very unlikely that they are the progeny of the large individual, and on the evidence are most likely to be males. Komai claimed to have identified testes as well as ova in large individuals of *S. pacificus*, but this statement is open to question in view of the absence of hermaphroditism in all known Copepods.

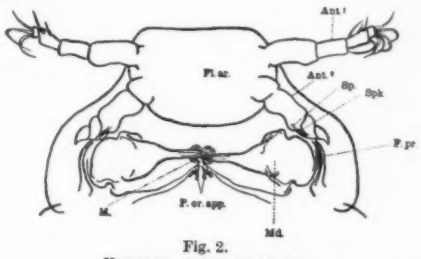

Fig. 2.

VENTRAL ASPECT OF HEAD.

Ant.¹, antennule; Ant.², antenna; Fl. ar., frontal area; F. pr., falciform process; M., mouth-opening; Md., mandible; P. or. app., postoral appendages; Spk., spike-like process; Sp., spine.

The stage of *S. arcticus* described above suggests that this species belongs to the Copepoda and, in view of its form would seem to be most closely related to the family Philichthyidæ.

Department of Zoology, University, Glasgow. July 17.

A. AITKEN.

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[5] Olsson, quoted by Hjort, *loc. cit.*

Preservation of Historic Machines and Apparatus

Care to ensure that nothing of permanent documentary value should be allowed to go to salvage during the present drive has been publicly emphasized by the Right Hon. Lord Greene, Master of the Rolls, as president of the British Record Association, as well as by other authorities.

The Council of the Newcomen Society directs attention to the corresponding need for watchfulness in the preservation by firms, public bodies and individuals, not only of documents but also of objects of enduring engineering and scientific interest. The Council had before it the case of the irreparable loss to Manchester of Richard Roberts's slide lathe of 1820 which was scrapped because "The lathe was very large and not complete [this was incorrect] and was seriously obstructing our work". A more recent attempt to scrap the contents of Wortley Iron Works near Sheffield, particularly two unique eighteenth-century tilt hammers, has fortunately been averted by prompt action. Such danger of destruction is greatest when the salvagers are enthusiastic but ill-informed persons.

The Council appeals for sufficient delay to get advice when in any doubt; there are several quarters that can give it, which the Society will be pleased to indicate if called upon.

E. LANCASTER BURNE (President).
H. W. DICKINSON (Hon. Sec).

Newcomen Society, 123 Riddlesdown Road, Purley, Surrey.

RESEARCH ITEMS

Fraternal Twins

J. W. MACARTHUR has made an analysis of the factors related to the production of fraternal twins (*J. Hered.*, **33**, 87; 1942). He points out that body size of the animals is correlated with the number in the litter. For example, seven generations of mice selected for body size in a plus direction weighed 27 gm. and produced 9–10 in a litter, whereas selected in a minus direction they weighed 14 gm. and produced 5–6 in a litter. Similar evidence is recorded from other animals. Twins are more prevalent among Nordic people than in the Mediterranean region, and the author points out that stature is greater in the more northern parts of Europe. Similarly, Negroes in the United States have a twin rate of 1 in 69 births, whereas the Japanese have the lowest known figure of 1 in 301. Twinning is believed to be inherited through both male and female lines, and to be largely dependent on those genes which influence body size.

Coiling of Chromosomes

TRILLIUM species provide valuable material for observations on chromosome coiling, which is considered by many cytologists to be of fundamental importance. G. B. Wilson and I. Hutcheson (*Canad. J. Res.*, **19**, 383; 1941) show that in *Trillium erectum* reversals in the direction of coiling across the attachment region are at random; across a chiasma there is a frequency of 1 : 6 : 1 of 0, 2 and 4 reversals in direction of coiling of the four chromatids. It is shown that there is an average of two reversals per chiasma. Reversals of direction take place without chiasma formation; once in approximately 17 gyres. There is thus, the authors contend, no grounds for a torsion theory of spiralization and no signs of an inherent ground pattern of structure that determines directions of coiling. A. H. Sparrow, C. L. Huskins and G. B. Wilson (*Canad. J. Res.*, **19**, 323; 1941) have studied the length changes of the meiotic and mitotic chromonemata in *T. erectum* and *T. grandiflorum*. Elongation occurs between early diakinensis and anaphase I and between anaphase II and prophase of the microspore division. Contraction occurs between zygotene and diakinesis, between anaphases I and II and during microspore and prophase. The authors discuss prevailing theories and put forward the view that the coiling is brought about by elongation of the chromomena within a space confined by the pellicle. It is probable that spirals of sister chromatids are always in the form of orthospirals (plectomenic), that is, they are interlocked at each twist. The authors show the importance of this evidence in considering the mechanism of chromosome behaviour.

Pacific Foraminifera

J. A. CUSHMAN now publishes the third part of his work on the Foraminifera of the tropical Pacific collections of the *Albatross*, 1899–1900 (United States National Museum, Bulletin 161; 1942). This deals with the families Heterohelicidæ and Buliminidæ. Certain other related material from shallow water of the same region is also included. Some interesting relationships have been noted in these faunas, in which are living representatives of species known hitherto only from the late Tertiary of other regions. The number of distinctive species in this area is very large. Many were originally described by H. B. Brady from the *Challenger* material. *Bolivinita quadrilatera* is a species occurring in the *Albatross* stations sometimes relatively abundantly, and also in 3–12 fathoms off Fiji. It apparently also occurs in the Atlantic, but it is an interesting fact that the Atlantic specimens as a rule seem to lack the basal spine. The fauna of the Miocene of France is related in many ways to the present Indo-Pacific fauna. It is therefore not surprising that a typical specimen of *Bolivinella margaritacea* described from the Miocene of France should have been found in the material from Rutavu.

Biology of Beetles of the Family Dermestidæ

MEMOIR 240 (Dec. 1941) of the Cornell University Agricultural Experiment Station is entitled "Studies on the Biology of Four Common Carpet Beetles". Part 1, dealing with three of the species in question, is by Grace H. Griswold, and Part 2, which is concerned with *Anthrenus scrophulariæ* only, is by Margaret Greenwald. It appears that very little detailed work has been done on these important pests. The black carpet beetle (*Attagenus piceus*), the varied carpet beetle (*Anthrenus verbasci*) and the furniture carpet beetle (*Anthrenus vorax*) are widely distributed throughout the world. The larvæ feed upon materials of animal origin and cause much damage to rugs, carpets, upholstered furniture, also woollens, furs, etc. The first two species also feed on cereal products and at times cause trouble in flour mills and granaries. In breeding these insects, woollen cloth of some kind has always been kept in each jar or receptacle and fish meal has proved satisfactory as a food for the larvæ. In all three species several months are spent as larvæ. For *A. piceus* the period was never less than 8 months and some individuals lived as long as 21 months. In the case of *A. verbasci* the larval life was slightly shorter but never less than 7 months, while in the case of *A. vorax* the period ranged from slightly less than 4 months to more than a year. The adult life in the first two species ranged from 13 to 44 days, whereas *A. vorax* lives as an adult from 44 to 251 days, the females living rather longer than the males. The fourth species, *Anthrenus scrophulariæ*, may pass its entire developmental period (egg to adult) in 78 days, but may be prolonged to at least 439 days. The beetle itself feeds upon pollen of various flowering plants—at least twenty-seven species of these being known to be resorted to. The paper includes a list of more than a hundred references to works on the insects in question.

Selachine as a Colour Neurohumour in Sharks

G. H. PARKER read a paper on this subject at the annual general meeting of the American Philosophical Society during April 23–25. In the common bull-head, the darkening of the fish is due to intermedine from the pituitary and acetylcholine from dispersing nerve terminals near the colour cells, and the blanching to adrenalin from concentrating nerve terminals also near the colour cells. In the smooth dogfish *Mustelus canis* darkening is due to the pituitary neurohumour intermedine. The occasion of its blanching is less clear. This colour phase has been variously claimed as due to the mere absence of intermedine, to a pituitary blanching agent, the *W*-substance, or to a concentrating nervous neurohumour. No evidence in favour of a *W*-substance has been found in Mustelus, but this fish does blanch on

loss of intermedine. When its integumentary nerves are cut the denervated areas become pale. Such blanching is not due to a disturbance in the blood supply, for it occurs when the blood vessels of the region are not interfered with. Such pale areas can be revived by recutting their severed nerves. From such skin a neurohumour can be extracted with ether or oil that will blanch a dark fish locally on injection. This neurohumour is in effect like adrenalin, but it is not adrenalin for it is not soluble in water and it is not destroyed by heat. It is peculiar to the shark; hence it has been called selachine. It causes blanching in Mustelus when the fish is low in its intermedine.

Water Reserves in Brazilian Forest Soils

THIS feature of some of the soil in the vast forest areas of Brazil is emphasized by Felix Rawitscher in his transpiration studies by rapid weighing methods under field conditions (*Anais da Academia Brasileira de Ciencias*, 14 (1), 1942). The soil depth in tropical and sub-tropical regions may reach a maximum of 15–20 metres, and considerable water reserves may be accumulated in the deeper layers of soil. During the dry period of the year these furnish water, not only to sources and streams, but also to the deeper plant roots. Large zones of humid forests in the interior of San Paulo live on these reserves during the dry period. The author suggests that the high transpiration rate of extensive humid forests must have a considerable influence on the humidity of the climate.

Amber Spiders

A. PETRUNKEVITCH'S well-known monograph on Carboniferous Arachnida is now supplemented by a lengthy study of spiders preserved in Baltic amber (*Trans. Connect. Acad. Arts. Sci.*, **34**, 119; 1942). The 140 specimens named represent 78 species, 69 of which are new, included in 27 families, 5 new. The descriptions are as detailed as the state of preservation allows, aided by a special technique, a full account of which is given. The work is illustrated by more than 500 line figures and 100 photographs. Prof. Petrunkevitch also summarizes the changes that evolution seems to have wrought in the structure of spiders, especially in the circulatory and respiratory systems, leading first to the conclusion that the habits of spiders must have become differentiated before the Oligocene, and secondly to much discussion as to the most acceptable way in which these evolutionary trends may be represented in the classification of the order. The monograph is both informative and provocative to a degree.

High-Pressure Measurements

Two further instalments of P. W. Bridgman's researches on the physical properties of substances at high pressures have been published (*Proc. Amer. Acad. Arts and Sci.*, **74**, 399 and 425; 1942). The first deals with freezing parameters and compressions of twenty-one substances, chiefly organic liquids, up to 50,000 kgm./cm.^{2}. The general conclusion from this new work in a pressure range three or four times the previous range is that the melting curves give no evidence for critical point, maximum temperature or temperature asymptote. The curves continue to rise to indefinitely high pressures and temperatures, with continually decreasing slope $d\tau/dp$ and continually decreasing volume discontinuity between solid and liquid. The second paper deals with pressure-volume relations for seventeen elements to pressures of 100,000 kgm./cm.^{2}. In general the compressibility falls off less with rising pressure than might have been expected. Full details are also given of the experimental technique needed to overcome the special difficulties of working at these higher pressures.

The True Galactic Pole

O. R. WALKEY has prepared an account of the various positions found for the galactic pole from the days of Sir William Herschel down to modern times (*Observatory*, No. 808, 64; June 1942). Of the twenty positions determined, seven were derived by the galactic belt, four from star counts, and nine from galactic objects. These are tabulated and are all reduced to the epoch 1900 position. The true position of the galactic north pole, using all the results, is at R.A. 12h. 48m., Dec. + 27°, in Coma Berenices (epoch 1900), and it is remarkable that this coincides exactly with Newcomb's combined position tabulated for the galactic belt. It seems highly probable that the epoch 1950 co-ordinates will be in use after the next meeting of the International Astronomical Union, in which case it will be sufficiently accurate to adopt the 1950 R.A. as 12h. 50m. and Dec. as + 27°.

Solar Eruption and Magnetic Storm of March 1-2, 1942

A PROBABLE connexion between the intense solar eruption of February 28d. 12h. and the magnetic storm which followed has been demonstrated by H. W. Newton (*Observatory*, No. 808, 64, June). M. A. Ellison at Sherborne observed the eruption first on Feb. 28d. 12h. 42m. U.T. in $H\alpha$, and from the presence of descending dark flocculi near the bright emission he inferred that the eruption had been in progress for some time. Observations were also made by P. Laurie with the Greenwich spectrohelioscope, but a cloudy sky prevented observations in the earliest stage of the eruption. While the average duration of a brilliant eruption is about $\frac{3}{4}$ hour, the eruption of Feb. 28 lasted for more than $3\frac{1}{2}$ hours—an exceptional time; but it is suggested that it may have consisted of multiple eruptions with the greatest integrated intensity between 12h. 0m. and 12h. 47m., and strong evidence for this view is given in the paper. On Feb. 28d. 12h. 0m. there was a sudden fade-out (ionospheric irruption of the Dellinger type) and this continued on some circuits until 20h. This was an abnormal duration for a fade-out of this type. A great magnetic storm commenced $19\frac{1}{2}$ hours after the beginning of this sudden fade-out and the following figures from the Abinger magnetic traces show the intensity of the storm:

D	9° 48·7′	at	1d.	9h.	30m.	to	11° 14·8′	at	1d. 7h. 51m.
H	0·18194		1	8	50		0·18706		1 9 59
V	0·43048		2	1	45		0·43224		1 9 59

These are the extreme ranges in each case.

Assuming that the ejection of the stream of corpuscles occurs about the time of peak intensity of the bright eruption, which is also closely indicated by the beginning of the radio fade-out, the time required by the stream to reach the earth was 19·4 hours. The data for Sept. 17–18, 1941, gave 20·5 hours and those for Feb. 28–March 1, 1941, gave 18·5 hours. Statistical evidence suggests that in the case of intense magnetic storms in areas where spectroscopic observations have located a brilliant solar eruption within the preceding $1\frac{1}{2}$ days, the effective time of travel is shorter than the mean.

OPEN-HEARTH FURNACE REFRACTORIES

THE first part of the joint meeting of the Iron and Steel Institute and the Society of Engineers and Metallurgists, held at Sheffield on May 19, was devoted to basic refractories, with particular reference to stabilized and semi-stabilized dolomite; and the second part was confined to a co-operative study of a silica roof trial on a basic open-hearth furnace. The discussion was based on reports and papers already published, to which reference is made in the appropriate footnotes.

Dolomite Refractories

The work described by Dr. J. R. Rait[1] has shown that when dolomite is stabilized, by the use of siliceous materials added before calcination, the principal mineral phases are tricalcium silicate ($3CaO.SiO_2$), periclase (MgO), brownmillerite ($4CaO.Fe_2O_3.Al_2O_3$) and dicalcium silicate ($2CaO.SiO_2$). Insufficient siliceous stabilizer leave some free lime which becomes hydrated and causes disintegration of the clinker, while excess results in the formation of dicalcium silicate ($2CaO.SiO_2$), which may cause 'dusting' at its β–γ inversion temperature (675° C.). If the iron oxide content of the mixture is more than that required to form brownmillerite with the available alumina, dicalcium ferrite ($2CaO.Fe_2O_3$) is also formed, whereas with excess alumina, tricalcium aluminate ($3CaO.Fe_2O_3$) appears.

The stabilization of dolomite by silicate minerals is dependent on the firing temperature as well as the proportions of the reactants. Owing to the limited stability range of $3CaO.SiO_2$ (1,300°–1,900° C.) care is necessary to avoid the formation of dicalcium silicate and free lime in a chemically balanced mixture. This breakdown of tricalcium silicate ($3CaO.SiO_2 \rightarrow 2CaO.SiO_2 + CaO$) may occur in the kiln firing of the clinker or in the firing of the bricks made from the clinker under certain conditions. Small quantities of some materials, for example, $Cr_2O_3.P_2O_5$, suppress the β–γ inversion of dicalcium silicate.

Study of the mineral constituents of stabilized dolomite was effected by X-ray diffraction apparatus, and examination of a number of materials showed that serpentine (used commercially), chromite and chromic oxide all produce clinkers highly resistant to hydration. Zirconia also gave promising results.

The relatively low resistance of fully stabilized dolomite to cracking when subjected to thermal shock is attributed to the physical condition of the material. Cracks, once started, are not stopped or deflected at grain boundaries but are propagated through the grains themselves. Better thermal shock resistance is usually shown by the semi-stabilized dolomite products, which have special spheres of usefulness.

A note by Dr. W. J. Rees[2] indicated that a semi-stable product containing 95 per cent dolomite, 2·5 per cent ball clay and 2·5 per cent mill scale might be used as a crushed aggregate and could be produced in a rotary kiln. The product has a high resistance to corrosion by basic-open-hearth slag and a fair resistance to thermal shock; also its resistance to hydration is such that it can be kept for some weeks without deterioration. It is possible to produce a partially stabilized brick by controlled firing in one operation, but the two-stage method (clinker → brick) is considered preferable as it gives a better shaped brick.

The production of dolomite bricks for use in steelworks was described[3], special attention being given to the replacement of magnesite refractories by stable or semi-stable dolomite bricks.

It has been shown that high-temperature calcination (or even electrical fusion) of dolomite does not yield a stable product. The magnesia and lime formed by the reaction: $CaCO_3.MgCO_3 \rightleftharpoons MgO + CaO + 2CO_2$ are both of moderate crystal size (about 0·5 mm. diameter) but the lime, unlike the magnesia, is readily hydrated after only a few days exposure to the atmosphere. The use of the term 'dead-burned' in connexion with high-fired dolomite is thus a misnomer.

During the last twenty years numerous attempts to stabilize dolomite have been made. Probably the first really successful works-scale experiments were those made in Great Britain in 1934 by Dr. W. H. Tyler and W. J. Rees[4], using a mixture of dolomite and sudanite rock (magnesite + talc). Nowadays, serpentine is used instead of sudanite rock, but the composition of all the fully stable dolomite bricks now in use in Great Britain is essentially the same as that employed in 1934, when dolomite brick technology was greatly advanced.

Apart from serious brick-to-brick variations in the early stages, two serious limitations arise periodically, namely, hydration in storage and 'dusting' in the furnace. X-ray examination showed the former to be due to insufficient silica content or inadequate firing (leaving uncombined lime), and the latter to the formation of dicalcium silicate. It is preferred in manufacture to keep the composition slightly on the silica-rich side of tricalcium silicate and add certain of the known stabilizers (for example, phosphorus pentoxide) to prevent the inversion of the small amount of dicalcium silicate so formed. The high-temperature breakdown of tricalcium silicate can lead to trouble in firing or in subsequent storage of the bricks.

The properties of stabilized dolomite bricks are characterized by porosity and permeability of the same order (20–25 per cent and 0·1 C.G.S. units) as those of magnesite bricks, good volume stability at 1,500° C. and high cold-crushing strength. Their refractoriness-under-load is high, but their thermal shock resistance is rarely greater than two reversals as compared with five to eight reversals for ordinary magnesite bricks. They do not disintegrate on boiling in water for 24 hours and show no free lime by the glycerol or White's test, while their thermal conductivity is little more than half that of magnesite. The analysis, which is determined largely by the silica requirements of the lime to form $3CaO.SiO_2$, shows about 15 per cent of silica and equal proportions of lime and magnesia.

Bricks of the semi-stable type were the first to give successful steelworks furnace service. Although containing free lime, the safe-storage time is sufficient for normal purposes, and better thermal shock resistance is obtained than with the fully stable brick. The storage time can be increased by impregnating the fired brick with organic stabilizers. Semi-stable bricks are usually made by mixing calcined dolomite ('basic') with suitable fluxes, moulding with the addition of a temporary bond such as tar and firing in the normal way.

The porosity is of the same order as that of stabilized bricks but the permeability may be higher.

While the crushing strength is usually adequate, it is often about half that of stabilized brick; but the refractoriness-under-load is fairly high. The thermal shock resistance is definitely superior (twenty reversals or more) and the resistance to slags high in iron oxide and lime is also greater. Chemically, this type of brick differs little from the ordinary 'basic' used for fettling open-hearth furnaces. Silica is slightly higher and the lime content normally exceeds the magnesia content to an extent determined mainly by the composition of the dolomite used.

Promising results, particularly as regards improved thermal shock resistance, have been obtained with mixtures of dolomite and magnesite, but such bricks are not yet manufactured commercially.

Basic Open-Hearth Furnace Roofs

Three factors have contributed largely to improved durability of basic open-hearth furnace roofs in recent years: (1) greater stability of the furnace structure; (2) use of temperature control; (3) slag control. Considerable advances have been made in the last few years as a result of co-operative effort by bodies such as the Open-Hearth Refractories Joint Panel, working under the ægis of the Iron and Steel Industrial Research Council and the council of the British Refractories Research Association.

A fairly complete history of a basic open-hearth silica brick roof[5] has been recorded, from the selection of the raw materials for the making of the bricks to the post-mortem examination of samples from the roof at the close of the furnace campaign.

The principal raw material was Bwlchgwyn quartzite. After initial crushing, dry grinding and mixing with a slurry containing a mineralizer, batch samples were taken for grading control and moisture determinations made. Pneumatic ramming of the bricks and modern drying and firing technique were employed. Specific gravity tests before and after firing indicated that pebbly varieties of the rock inverted to the low specific gravity forms (tridymite and cristobalite) more readily than the normal or non-pebbly Bwlchgwyn rock.

Maintained loads refractoriness-under-load tests at a constant temperature of 1,600° C. were made on the fired bricks. A small expansion at 25 lb./sq. in. and a small subsidence at 50 lb./sq. in. load in a one-hour test showed the suppression of permanent expansion by increased loading and suggested that little, if any, permanent expansion would occur in a roof loaded by its own weight. The permanent expansion of a number of the bricks, determined by heating for 2 hours at 1,500° C., showed good volume stability. Higher values were found for bricks of 2·31 specific gravity than for those of 2·32 specific gravity, although it would appear probable that the tridymite (sp. gr. 2·27) content of the lower specific gravity bricks would exceed that of the others and would tend to revert to cristobalite (sp. gr. 2·32) during the test.

Extensive temperature measurements made by means of rare- and base-metal thermocouples embedded in the roof and a radiation pyrometer permanently sighted on the inside centre of the roof gave a record of temperature fluctuations and temperature gradient throughout the campaign. From the records just prior to gassing the furnace, it was shown that the stack draught was sufficient to draw air through the roof when the stack damper was raised, the temperature near the outer face of the roof falling much more than that in the middle of the brickwork. The hot face of the roof fell from 600° C. to 350° C. in 10 minutes, but not into the range where spalling was likely to occur as a result of the β-α cristobalite inversion, although it was well below the β-α quartz inversion temperature.

The temperature records taken over a complete heat were particularly interesting and showed fluctuations as large as 200° C. during charging of the furnace, but fairly steady conditions during melting and refining. On tapping the furnace, the hot-face temperature rapidly fell 300-400° C. and this chilling appeared with an increased time-delay and diminished amplitude through the roof section towards the cool outer face. At a point 9 in. behind the hot face, the maximum cooling occurred some four hours after the event which initiated it.

Some doubt which has previously existed as to the true significance of temperature readings taken with a radiation pyrometer with flame in the furnace seems to have been clarified, by the observation that when the radiation pyrometer showed a fluctuation of about 50° C. at gas and air reversals, the thermocouple initially ½ in. inside the brick from the hot face recorded a slower fall of about 20° C. It thus appears improbable that the 'flame error' of the radiation pyrometer is more than 10-20° C. and frequent records showing roof surface temperatures in excess of 1,700° C. indicated that this temperature may actually be attained in working without visible damage to the bricks, although the fusion temperature of a seasoned roof has been placed at 1,650° C. The reason for this high-temperature stability of open-hearth roof silica bricks was shown to depend partly on the inhomogeneity of the brick. When a test was made on a portion of brick rendered more homogeneous by crushing to powder, the refractoriness appeared to be some 40° C. lower than before crushing. The high-temperature stability of the continuous cristobalite skeleton is also of undoubted importance, as has been noted in silica bricks from other portions of the furnace containing much greater quantities of ferrous oxide. The temperature gradient through the roof underwent a pronounced change during the first two weeks of the nineteen weeks campaign. The region a short distance behind the hot face became a better thermal conductor as 'seasoning' developed, so minimizing the temperature drop in this part of the brick. It has been further suggested that the size, shape and ordination of the crystals may influence the thermal conductivity so as to produce a change of slope in the temperature gradient near the 1,470° C. isothermal (transition from the grey cristobalite to the black tridymite zone).

Several analyses of the dust in the furnace atmosphere at various stages of the heat wave have shown that, during charging, the dust is mainly iron oxide, lime and dolomite; during melting, chiefly iron oxide and lime with lesser quantities of alumina and silica; and during refining, it consists mainly of lime with smaller proportions of iron oxide, alumina, silica and magnesia. The rate of dust production was highest during charging and least during melting, as might be expected.

The dust in the outgoing gases passes into the regenerators where slagging of the brickwork filling is caused. Analyses of the slagged surfaces of bricks from both air regenerators illustrated this attack.

At the end of the campaign, sample bricks were selected from certain areas of the roof for detailed

laboratory examination. Chemical analyses of the various coloured zones generally confirmed the results of previous investigators. Sulphur trioxide and phosphorus pentoxide have not generally been determined in earlier studies, and this work has thrown some light on their occurrence in open-hearth roof bricks. Nearer the hot face, SO_3 was less than 0·2 per cent, but increased suddenly to nearly 0·6 per cent in the reddish cool end of the brick. The concentration of sulphur in this area is believed to have come from the furnace atmosphere, possibly during the making of certain free-cutting steels involving the addition of pyrites to the bath.

Phosphorus pentoxide remained fairly constant throughout the hotter half of the brick and then fell to a mere trace. Nowhere did the P_2O_5.CaO ratio approach that in the slag, nor were the positions of the two maxima coincident. This observation supports the view that the slagging agents in the furnace atmosphere contain but little furnace slag. Small amounts of lead, tin and copper were found in the roof brick, but the volatile zinc oxide was quite absent though abundant in the furnace flues.

Stalactites which formed on the underside of the roof, during the campaign, were found to resemble the hot face of the brick in composition, but the $FeO.Fe_2O_3$ ratio nearly corresponded with that prevailing in the cooler portions of the black tridymite zone behind. This region of the brick was found to be less refractory than any other.

There was a general decrease of porosity towards the hot end of the roof bricks, which is in accord with the findings of previous investigators. Calculation, however, showed that the weight of absorbed fluxes is insufficient to account for the observed fall in porosity, and it must be assumed that some of the fluid glaze formed on the hot face is itself drawn up into the pores of the brick.

The region between the black tridymite and yellow zones, found in used roof bricks, has been shown to be of very low permeability. Microscopical work has confirmed this observation and indicated the presence of a narrow glassy continuum between the silica grains.

Microscopical examination of thin sections cut from the various zones has confirmed the observations of other workers on the stability of the various silica allotropes. The particular allotropes and their relative abundance in any given area have also been studied by coefficient of expansion curves and X-ray diffraction methods.

The formation of a eutectic between mellorite (a complex lime - ferric oxide - silicate of garnet type) and silica (tridymite or cristobalite) melting at about 1,160° C. was observed and is a factor of importance in determining the life of roof bricks.

It has also been shown that furnace gases can pass through the brick, and sulphur compounds in the gases attack the glassy matrix forming ferric sulphate or ferric oxide, depending on the prevailing temperature.

[1] "Second Report on Refractory Materials." Iron and Steel Inst., Spec. Rep. No. 28, pp. 13–99 (1942).

[2] "Second Report on Refractory Materials." Iron and Steel Inst., Spec. Rep. No. 28, 101 (1942).

[3] Swinden, T., and Chesters, J. H., "Dolomite Bricks for use in Steelworks," *J. Iron and Steel Inst.*, No. 2, 105*P* (1941).

[4] *Trans. Ceramic Soc.*, **33**, 104 (1934).

[5] "A Co-operative Investigation of the Factors Influencing the Durability of the Roofs of Basic Open-Hearth Furnaces". Report by the Open-hearth Refractories Joint Panel, *J. Iron and Steel Inst.*, No. 2, 203*P* (1941).

CAMBRIDGE SCIENTIFIC WORKERS AND THE WAR

ALTHOUGH recent surveys of the utilization of science in the War have tended to concentrate upon the situation in industry and in Government service, it must be remembered that the universities are carrying on a considerable volume of war research in addition to their main function of teaching. A critical review of the actual and potential war function of university research laboratories in Great Britain would provide a useful addition to present information, and their position must certainly be considered in any national scheme for the co-ordination of research. It is opportune, therefore, that on July 20 the Cambridge University Branch of the Association of Scientific Workers convened a meeting to discuss these points as they affect Cambridge. There was an attendance of more than a hundred, and contributions were forthcoming from research workers in most of the principal departments of the University.

A number of speakers reported on the general experience of their laboratories, other members of which supplemented their remarks in the discussions. The situation obviously varies considerably from department to department, but it is clear that some important difficulties are common to all. The main shortcomings may be summarized as: (1) lack of really important or urgent war problems in some laboratories, and the difficulty of obtaining such problems; (2) continuance of academic research or, more frequently, occupation with 'pseudo' war research; (3) difficulty of effecting contact with workers in the same field in Government institutions or in industry; (4) hampering effect of secrecy regulations, which appear to be sometimes absurdly stringent; (5) lack of organized collaboration, including pooling of equipment, between the University departments; (6) difficulty under the present University regulations of employing Ph.D. research students on war work, particularly secret work and work carried on by research teams; (7) absence of pooling of scientific teaching with the evacuated universities and colleges in Cambridge (the Cavendish Laboratory is a notable exception).

As was pointed out by the chairman, there are many scientific workers in Cambridge engaged on secret work of national importance, and their work could not be discussed at such a meeting. Hence the discussion possibly tended to place emphasis on the less satisfactory aspects of the situation. It is precisely these which most urgently need attention, however, and the volume of work represented was considerable.

The first two points are conveniently considered together. In the field of organic chemistry, for example, many of the post-graduate research students are working on problems recommended by the Advisory Research Council of the Chemical Society. It was stated that the majority of these problems are long-term problems related to the improvement of the post-war prospects of the chemical industry; there is considerable dissatisfaction about this. Many senior members having left to do war-work, a considerable amount of teaching is carried on by the junior members of the laboratory, and it is undesirable to transfer all of them to posts elsewhere. The solution lies more in their being provided with the right sort of problems to solve. The situation is

markedly better on the physical or colloid chemical side, where work is being done arising largely out of Service requirements, although some of it is rather long-term in nature. In 'pure' biochemistry it might be argued that there are very few real war problems at all, and this has led to quite a few research workers either continuing with academic research or taking up what might aptly be called a 'pseudo' war problem. It is necessary for biochemists to branch out into the related and more immediately useful fields of nutrition, medicine, bacteriology, agriculture and industrial fermentation. Difficulties here are the sketchy organization of biochemists for war purposes and the generally unco-operative attitude of industry.

The difficulty of meeting or corresponding with colleagues engaged on the same or similar work was instanced by speakers from various laboratories. The official attitude is often one of discouragement or even surprise, and many workers seem to have to rely on chance personal contacts. The stringency of secrecy regulations is sometimes too great, and has the undesirable effect of hampering the progress of work by preventing discussion with other scientific workers attacking similar problems. It is often particularly difficult for university men to obtain the necessary collaboration with industry or with Government laboratories.

The position of Ph.D. students was touched on by several contributors to the discussion. It is necessary to decide whether such persons are students being trained in some specialized branch of science, or whether they should be regarded as scientific workers of adequate experience to carry out successfully certain specific pieces of war work. The general opinion favoured the latter course as being more in line with the urgent needs of the situation, but it was felt that a modification of the University regulations to meet this point is necessary. Provision for students to submit secret war work in a dissertation for a higher degree has been made with apparent success in other universities, notably Oxford. Apart from secrecy precautions, there are difficulties in assessing a student's work if he has been working in a research team or has been engaged on a number of small isolated problems.

The crux of the matter was brought out by one speaker who gave a definition of war research. Scientific work can only be considered as war work when it is *very probable* that it will give results which can be applied to *this* War. Any other form of research is either 'pseudo' war work, or not war work at all. In particular, the urgent need for technical advance in the present critical war situation must be realized. Probably the prime need is for individuals to appreciate their responsibilities to the nation, and themselves actively set about obtaining definite war problems. Difficulties, often considerable, do exist, but they must be expected and overcome. Many university scientific workers need to change their outlook and stop looking for a major research project in short-term pieces of work. Much of the difficulty arises because academic scientific workers are tempted too much to pick and choose their subjects for research. The essential thing now is the usefulness of the research, not its inherent scientific interest. They should be prepared to change over to completely new fields if there is little of direct application in their own, or even to take up work of a more routine nature. A man called up into the Forces has to learn a completely new art, so why not the man of science, who after all is in a sheltered position in the War ?

While the meeting emphasized the need for personal initiative and hard work on the part of the individual man of science, it was clearly in no doubt that the setting up of a national body with executive power to plan scientific work is long overdue. A resolution, which was unanimously carried, gave expression to this opinion by supporting wholeheartedly the demands for a Joint Technical Board or Technical Planning Committee "with executive authority to co-ordinate research, design and development", and pointed out the necessity for such a body having the closest contacts with rank-and-file scientific workers. The maximum effort of Cambridge men of science to help the war effort was promised, and it was urged that, subject to necessary conditions of secrecy, *all* scientific workers engaged on similar problems or employed in the same place shall meet regularly to discuss progress and plan future advance.

COBALT-NICKEL DEPOSITION

AN article in the *Electrical Review* of July 3 by C. C. Downie describes the developments which have taken place in the last three years on research into the deposition of cobalt-nickel alloy. This alloy is at least three times as hard as nickel itself, and is more resistant to corrosion than either cobalt or nickel alone. Moreover, the process is within the bright plating category which obviates the need for subsequent buffing or polishing. The nickel used is electro-refined wire or strip and is even purer than the product obtainable from the carbonyl process. The best metallic cobalt to use is that obtained by special reduction of the oxide, such as by the Kalmus process, which is completely free from carbon and practically all other solid impurities. For all smaller work it suffices to use nickel and cobalt inter-wound in the form of wire or strip, to present a uniform surface closely akin to a solid anode.

Nickel is analysed by the dimethylglyoxime method and cobalt by the nitroso-β-naphthol method. For initial experiments the cathode may be of platinum sheet, so that all features of the deposition at different current densities and concentrations of the two metals can be followed, before commencing operations. The deposits can be made very ductile, so as to bend or twist without any tendency to lift or peel, while what is known as 'double-plate' is rarely encountered.

Earlier work done by Fink and Lah proved the wide range of silver-white deposits which could be obtained from different cobalt-nickel compositions, which in combined chloride-sulphate baths can contain 55–75 per cent of nickel with 45–25 per cent of cobalt. Afterwards, Young and Gould found that the mixed bath can provide almost any desired composition of deposit at a current density of from 10 to 30 amp./sq. ft., with or without agitation. Researches by Brockman and Nowlen showed that the density can be increased to between 32 and 144 amp./sq. ft. with a different type of electrolyte. Advantage has been taken of a similar composition for the dual deposition in a bath consisting (in oz./gal.) of 26·1 nickel sulphate crystals, 4·7 cobalt sulphate crystals, 2 sodium chloride, and 3·25 boric acid, maintained

at 20° at a *p*H value of 5·5–5·8 at a maximum of 30 amp./sq. ft.

This composition gives appreciable control of the two metals, for if the temperature of the bath be increased the proportion of cobalt will be increased with a corresponding diminution of the nickel. Alternatively, by increasing the speed of rotation of the cathode, the nickel proportion can again be decreased. To reduce the cobalt proportion the current density only need be suitably decreased, while by lowering the *p*H towards acidity the alloy deposited acquires directly an increased nickel content at the expense of the cobalt. The introduction of triethanolamine makes it possible to deposit almost any proportions of cobalt and nickel.

The composition of such alkaline baths (in oz./gal.) is 10·7 nickel sulphate crystals, 4 nickel chloride crystals, 4 anhydrous sodium sulphate, and 16 triethanolamine, together with a second solution composed of 10·7 cobalt sulphate crystals, and 13·5 triethanolamine. In the latter instance the temperature of the bath is maintained at 23° C. and the two solutions are added in measured proportions as required. The corrosion-resisting properties of the combined cobalt-nickel deposit by far exceed those of the constituent metals, while the range of hardness, ductility and toughness is still further increased. The last two mentioned qualities are of special importance in the plating of stereotypes, where brightness is of no great account. The printing surface must withstand wear for lengthy periods without deteriorating, in which respect cobalt-nickel deposit has been of great practical value. The same type of deposit has been applied to the manufacture of rayon and other artificial silks, to surfaces which are exposed to heavy wear in regular textile mills and in modern laundry practice. In various instruments, automatic machines, and the finer parts of acoustic devices, cobalt-nickel deposit is preferred on account of the wide range of physical properties available.

APPOINTMENTS VACANT

APPLICATIONS are invited for the following appointments on or before the dates mentioned:

ASSISTANT CHEMIST (MALE OR FEMALE)—The Clerk and Manager, West Midlands Joint Electricity Authority, Phœnix Buildings, Dudley Road, Wolverhampton (endorsed 'Assistant Chemist') (August 14).

LECTURER IN ENGINEERING at the Walker Technical College, Oakengates—The Secretary for Education, Education Office, County Buildings, Shrewsbury (August 15).

GRADUATE LECTURER IN BIOLOGY at the Crumlin Mining and Technical College—The Director of Education, Higher Education Department, County Hall, Newport, Mon. (August 15).

ENGINEER AND SECRETARY TO THE ISLE OF MAN ELECTRICITY BOARD—The Chairman of the Isle of Man Electricity Board, Electric House, Circular Road, Douglas, Isle of Man (endorsed 'Appointment of Engineer and Secretary') (August 17).

GRADUATE LECTURERS IN MECHANICAL AND ELECTRICAL ENGINEERING at the Lincoln Technical College—The Director of Education, City Education Office, 4 Lindum Road, Lincoln (August 17).

ASSISTANT TO THE CHIEF RESEARCH OFFICER OF THE MENTAL DISEASE RESEARCH DEPARTMENT—The Secretary, The University, Birmingham (September 1).

UNIVERSITY CHAIR OF CHEMISTRY, tenable at the Royal Cancer Hospital—The Academic Registrar, University of London, Richmond College, Richmond, Surrey (September 1).

DIETITIAN—The Secretary, University College Hospital, Gower Street, London, W.C.1.

GRADUATE ASSISTANT MASTER TO TEACH CHEMISTRY in the Bury Municipal (Evening) Technical College and GENERAL SCIENCE SUBJECTS in the Bury Junior (Day) Technical School—The Director of Education, Education Offices, Bury.

TEACHER IN ENGINEERING—The Principal, County Technical College, Gainsborough, Lincs.

SCIENTIFIC ASSISTANT (WOMAN), WITH KNOWLEDGE OF LANGUAGES AND UNIVERSITY STANDARD QUALIFICATIONS IN PLANT SCIENCE—The Deputy Director, Imperial Forestry Bureau, Oxford.

FORTHCOMING EVENTS

Wednesday, August 12

INSTITUTE OF CHEMISTRY (LONDON AND SOUTH EASTERN COUNTIES SECTION) (at Kodak Hall, Harrow), at 6 p.m.—Dr. J. Grant: "Chemist versus Forger".

Friday, August 14

ROYAL ASTRONOMICAL SOCIETY (at Burlington House, Piccadilly, London, W.1), at 4.30 p.m.—Geophysical Discussion on "The Figure of the Earth" (to be opened by Sir Gerald Lenox-Conyngham, F.R.S.).

Sunday, August 16

ASSOCIATION OF SCIENTIFIC WORKERS (at the Institution of Mechanical Engineers, Storey's Gate, Westminster, London, S.W.1), at 3 p.m.—Conference on "The Scientific Film and Scientific Film Societies".

REPORTS and other PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

Report of the Marlborough College Natural History Society for the Year 1941. (No. 90.) Pp. 30. (Marlborough: Marlborough College.) 2*s.*; to non-Members, 5*s.* [217

Transactions of the Royal Society of Edinburgh. Vol. 60, Part 2, No. 17: The Genus Primula, Section Nivales. By Sir W. Wright Smith and Dr. H. R. Fletcher. Pp. 563–627. (Edinburgh and London: Oliver and Boyd.) 8*s.* [227

Department of Scientific and Industrial Research. Index to the Literature of Food Investigation. Vol. 13, No. 3, December 1941. Compiled by Agnes Elisabeth Glennie, assisted by Catherine Alexander. Pp. iv+157–232. (London: H.M. Stationery Office.; 4*s.* 6*d.* net. [247

Other Countries

Scientific Publications of the Cleveland Museum of Natural History. Vol. 8, No. 4: The Infero-Gnathal Plates of *Titanichthys*. By David H. Dunkle and Peter A. Bungart. Pp. 49–60. Vol. 8, No. 5: A New Fossil Fish of the Family *Leptolepidæ*. By David H. Dunkle. Pp. 61–64+plate 6. (Cleveland, Ohio: Cleveland Museum of Natural History.) [207

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